Appendix C

Project Calculations and Analyses

OU 1-10 Group 3, EDF LOG

EDF-096-001	TSF Excavation Quantities Calculations
EDF-096-002	Waste Stream Quantities
EDF-096-003	Crane Lifting Calculations
EDF-096-006	Waste Contents Density Evaluation
EDF-096-008	Brokk 330D Specification Sheet
EDF-096-009	RUBB Building Systems Specifications and Vendor Quotes
EDF-096-010	Excavation Quantities Calculations
EDF-096-011	Radiological Modeling Calculations
EDF-096-012	PM-2A Half Tank Rigging
EDF-096-012A	TSF-26 PM2A Half-Tank Lifting Lugs Design
EDF-096-013	PM-2A Half Tank Cover
EDF-096-014	PM-2A Half Tank Positive Air Flow System
EDF-096-016	Project Stormwater/Drainage Design
EDF-096-017	PM-2A Tank Excavation Slope Stability
EDF-096-018	Knockdown Hopper Frame Design
EDF-096-019	ICDF Landfill WAC Evaluation
EDF-096-021	PM-2A Tank Cutting System
EDF-096-022	PM-2A Tank Packaging System
EDF-096-023	PM-2A Half-Tank Cover Supports

intrepid technology & resources incorporated

ENGINEERING DESIGN FILE

EDF 096-001
Rev. No. 0
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EDF Title: **TSF-26 EXCAVATION QUANTITIES CALCULATIONS**

Project No.: 2000-096 | Project Title: OU 1-10, TSF-26 REMEDIATION

Project Specific Activity: EXCAVATION QUANTITIES CALCULATIONS

Problem Statement:

Calculate the Excavation and Fill Quantities for the PM-2A Tanks Site - TSF-26 (V-13 [East Tank] and V-14 [West Tank]) Remedial Action Operations. Includes the following breakdown of material types:

- Excavated "Clean Materials" [No Radiological Contamination above Established Limits] - Stockpiled at Site
- Excavated "Contaminated Materials" [Radiological Contamination above Established Limits] - Disposed of at ICDF
- Required Imported Engineering Backfill Materials
- Required Imported Topsoil

Summary of Conclusions:

TSF-26 Site:

- Excavated "Clean Materials" ==> 5,302 cubic yards
- Excavated "Contaminated Materials" ==> 164 cubic yards
- Imported Engineering Backfill Materials ==> 13,404 cubic yards
- Imported Topsoil ==> 1,103 cubic yards

REVIEW AND APPROVAL SIGNATURES:

	R/A	TYPED NAME/ORGANIZATION	SIGNATURE	DATE
PREPARED BY:		D. J. Kenoyer		10/20/03
CHECKED BY:		KEVIN SHABER		10/20/03
INDEPENDENT REVIEWER		ORB		
APPROVAL:		GARY MECHAM		10/21/03

Distribution:

Registered Professional Engineer's Stamp (if required)

PROBLEM STATEMENT:

TSF-26 Site Remediation Operations require the removal of overburden above the PM2A Tanks [V-13 (East Tank) and V-14 (West Tank)] and concrete cradle system. The excavation must be sized sufficiently large to allow all remedial operational activities to be performed including:

- Demolition of Tanks themselves
- Placement of Containment Structures
- Placement of Waste Removal Equipment
- Equipment and Personnel Access

ASSUMPTIONS:

The assumptions utilized in the performance of these calculations are outlined below:

- Soil Classification Allows the Utilization of 1:1 Side Slope due to Soil Cohesion and Stability [Conclusion from soil sampling radiological survey data - accomplished in May 2003 by BBWI]
- General PM2A Site within the Fenced Perimeter was Previously Excavated to a depth approximately 5'0" below "Surrounding Grade" [Excavation to existing surface elevation to spring line of tanks approximately 16'0"]
- Only 3.0% of the PM2A Mass Excavation considered "Contaminated" and must be packaged in Roll-Off Containers with "Burrito Bag Liners" [Conclusion from soil sampling radiological survey data - accomplished in May 2003 by BBWI]
- Compaction Factor of 7.0% was utilized in calculating the cubic yards of Engineered Backfill Materials needed to be imported from TAN Pit [located North of SMC]
- Compaction Factor of 5.0% was utilized in calculating the cubic yards of Topsoil Materials needed to be imported from TAN Pit [located North of SMC]

REFERENCES:

CALCULATIONS / ANALYSIS:

See Attached Excel Spreadsheet Calculations based upon PM2A Site Physical Configuration and above stated considerations for excavation sizing development.

Intermountain technology & resources incorporated

INEEL BBWT RFP-394 RD/RA Work Plan for WAG 1-10 ===> PM2A Tanks - Excavation Quantities Calculations

WAG 1-10 Sites TSF-26, TSF-03, and WRRTF-01

Additional Breakdown of Quantities, 26-Jun-03, prepared by DJ Kenoyer, Checked by
Checked 90% Design - 26-Jun-03, DJ Kenoyer, Verified by Shaun Dustin
Assumed Average Depth of Excavated Area from PM2A Site ===> 5.0
No Gravel Pad required for Crane / Side Slopes 1:1 vs. previous 1.5:1

East Section of PM2A (PM2A Excavation Eastern Edge to East Site Boundary Fence)

Description	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*			
Mass Backfill - Total Area	144.0	192.0	5.0	27,648.0	138,240.0	5,120.0		7%	Compaction
Mass Backfill - Total Area	144.0	192.0	3.0	27,648.0	82,944.0	3,072.0		3,287.0	IntFill
Crane Lifting Platform - Gravel	60.0	70.0	-	4,200.0	-	-	Gravel	-	
Mass Backfill - Engineered Materials				23,448.0	138,240.0	5,120.0	Backfill	5,478.4	

West Section of PM2A (PM2A Excavation Western Edge to West Site Boundary Fence)

Description	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*			
Mass Backfill - Area 1	84.0	216.0	5.0	18,144.0	90,720.0	3,360.0		7%	Compaction
Mass Backfill - Area 1	84.0	216.0	3.0	18,144.0	54,432.0	2,016.0		2,157.1	IntFill
Mass Backfill - Area 2	36.0	90.0	5.0	3,240.0	16,200.0	600.0			
Mass Backfill - Area 2	36.0	90.0	3.0	3,240.0	9,720.0	360.0		360.0	IntFill
				21,384.0	106,920.0	3,960.0			
Crane Lifting Platform - Gravel	60.0	70.0	-	4,200.0	-	-	Gravel	-	
Mass Backfill - Engineered Materials				17,184.0	106,920.0	3,960.0	Backfill	4,237.2	

Main Excavation Section of PM2A (PM2A Excavation)

Description	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*			
Mass Backfill - Area 1	114.0	120.0	5.0	13,680.0	68,400.0	2,533.3		7%	Compaction
Mass Backfill - Area 2	54.0	78.0	5.0	4,212.0	21,060.0	780.0			
Mass Backfill - Area 3	24.0	30.0	5.0	720.0	3,600.0	133.3			
				18,612.0	93,060.0	3,446.7	Backfill	3,687.9	

PM2A Main Area - Within Site Boudary Fence

Description	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*			
Topsoil - Area 1 - North Section	130.0	357.0	0.5	46,410.0	23,205.0	859.4		5%	Compaction
Topsoil - Area 2 - South Section	57.5	153.5	0.5	10,361.3	5,180.6	191.9			
				56,771.3	28,385.6	1,051.3	Topsoil	1,103.9	
							Gravel	-	cubic yards
							Backfill	13,403.5	cubic yards
							Topsoil	1,103.9	cubic yards

Checked 90% Design - 26-Jun-03, DJ Kenoyer, Verified by Shaun Dustin
No Interim Backfill Operations - Stockpiling ONLY

Excavtion Spoils Pile Configuration

Description	*Slope*	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*		
Excavation Spoils Pile No. 1 - Located in Southwestern Corner									
- Bottom		75.0	140.0		10,500.0				
- Top	1.0	35.0	100.0		3,500.0				
	1:1 slopes			20.0	7,000.0	140,000.0	5,185.2	5,185.2	Stockpile - 1
Excavation Spoils Pile No. 1 - Located in Southwestern Corner - After Initial Fill 3'0" of Western Area									
- Bottom		75.0	140.0		10,500.0				
- Top	1.0	57.0	122.0		6,954.0				
	1:1 slopes			9.0	8,727.0	78,543.0	2,909.0	2,517.1	Interim Fill 3'0" Western Area
								2,948.5	
Excavation Spoils Pile No. 2 - Located in Northeastern Corner									
- Bottom		60.0	100.0		6,000.0				
- Top	1.0	60.0	100.0		6,000.0				
				-	6,000.0	-	-	-	Stockpile 2
								5,185.2	Stockpile Totals
							PM2A Tank Excavation ===>	5,465.6	

Additional Breakdown of Quantities, 15-Mar-03, prepared by DJ Kenoyer, Checked by
Checked 90% Design - 17-May-03, DJ Kenoyer, Verified by Shaun Dustin
===> Maintain 1.0:1 Side Slopes Until Soils Geologic Data Received, Reviewed, and Engineering Analysis Performed

Main Excavation with 1.0:1 Side Slopes

Description	*Slope*	*width (lineal feet)*	*length*	*depth*	*Area (square feet)*	*volume (cubic feet)*	*(cubic yards)*
Main Tank Excavation							
- Bottom		59.0	85.0		5,015.0		
- Top	1.00	91.0	117.0		10,647.0		
				16.0	7,831.0	125,296.0	4,640.6
PM2A Tank Volumes	*number*	*diameter*	*length*	*exposed*			
Tanks	2	12.5	55.0	0.5		(6,749.5)	(250.0)
Access Manholes	2	5.5	12.0	1.0		(570.2)	(21.1)
		Note 1					(271.1)

Ramp										
- Bottom		12.0	96.0		1,152.0					
- Top	1.00	39.9	96.0		3,833.0					
				16.0	2,492.5	19,940.1	738.5			
							5,108.0			
				Soil Expansion Factor ==>		7.0%	357.6			
				Minimum Required Import for Engineering Materials ==>			5,465.6	Backfill	5,465.6	cubic yards
								Gravel	-	cubic yards
								Backfill	**18,869.1**	cubic yards
								Topsoil	**1,103.9**	cubic yards

Waste Boxes for Contaminated Soil Removal Operations

	height	*width*	*length*	*capacity*		*cubic feet*	*cubic yards*
Standard Steel Box	4.0	4.0	6.0	10,000	lbs	96.0	3.6
Fabric Soil Sacks	6.0	6.0	10.0	25,000	lbs	360.0	13.3
Roll-Off Container Liner	3.5	7.2	22.0		lbs	551.3	20.4

		Excavated Soil & Previously Excavated Soil Volume ==>	5,108.0	cubic yards
Waste Expansion Factor ==>	7.0%	Estimated Expanded Waste Volume ==>	**5,465.6**	cubic yards
Assumed Percentage of PM2A Soil Excavation of Radiologically Contaminated Soils				
		Assumed Percentage ==> 3.0%	164.0	cubic yards

8 each - Rolloff Containers Staged Required
5 each - Rolloff Containers Staged in NE Corner

Number of Standard Steel Boxes Required ==>		1,540	each		67	each
Cost for Standard 4'0" x 4'0" x 6'0" Steel Waste Container at the INEEL ==>	$	550.00	each	$	550.00	each
Estimated Cost for Steel Waste Containers ==>	$	***847,000***		$	36,850	
Number of Standard Soil Sacks Required ==>		410	each		18	each
Cost for Standard Soil Sack Container at the INEEL ==>	$	300.00	each	$	300.00	each
Estimated Cost for Fabric Waste Containers ==>	$	***123,000***		$	5,400	
Number of Standard Roll-Off Containers Required ==>		270	each		12	each
Cost for Standard Roll-Off Container at the INEEL ==>	$	-	each	$	-	each
Cost for Standard Roll-Off Container Liner at the INEEL ==>	$	250.00	each	$	250.00	each
Estimated Cost for Roll-Off Waste Container Liners ==>	$	***67,500***			3,000	
Cost for Standard Roll-Off Container - RENTAL Fees ==>	$	-	per week	$	-	per week
Standard Roll-Off Container - REQUIRED ==>		270	each		12	each
Estimated Cost for Roll-Off Waste Containers ==>	$	-		$	-	
Estimated Total Cost for Roll-Off Waste Containers ==>	$	67,500			3,000	

Notes

1 per the EGG-2236 FINAL Report D&D of TAN PM-2A System, March 1983 / Figure 2-7. Arrangement of PM-2A holding tank manway

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ENGINEERING DESIGN FILE

EDF 096-002
Rev. No. 2
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EDF Title: **TSF-26 WASTE STREAM QUANTITIES CALCULATIONS**	
Project No.: 2000-096	Project Title: OU 1-10, TSF-26 REMEDIATION
Project Specific Activity: WASTE STREAM QUANTITY CALCULATIONS	

Problem Statement:

Calculate the Waste Stream Quantities for the PM-2A Tanks Site - TSF-26 AOC (Area of Contamination) (V-13 [East Tank] and V-14 [West Tank]) Remedial Action Operations. Includes the following breakdown of Waste types:

- MLLW - Soil [Contaminated Soils]
- MLLW - Debris [Contaminated Piping, Metals, PPEs, Rags, Other Disposable Items, etc.]
- MLLW - Sludge / DE Waste [Waste from Tanks V-13 & V-14]
- MLLW - Liquid [Decontamination Water from Sampling and Equipment Decontamination Operations]
- MLLW - Debris [PM2A Tanks]
- MLLW - Debris [Decontamination of Support Equipment and Ancillary Systems - RUBB Enclosures, Vacuum System, etc]

Summary of Conclusions:

TSF-26 Site:

- MLLW - Soil ==> 164 cubic yards
- MLLW - Debris ==> 393 cubic feet
- MLLW - Sludge / DE Waste ==> 6,020 gallons / 804.4 cubic feet
- MLLW - Liquid ==> 375 gallons
- MLLW - Debris [PM2A Tanks] ==> 165 cubic feet MINIMUM / 2,281 cubic feet MAXIMUM
- MLLW - Debris ==> 539 cubic feet

REVIEW AND APPROVAL SIGNATURES:

	R/A	TYPED NAME/ORGANIZATION	SIGNATURE	DATE
PREPARED BY:		D. J. Kenoyer		21 Oct-03
CHECKED BY:		KEVIN SHABER		10/20/03
INDEPENDENT REVIEWER		ORB		
APPROVAL		GARY MECHAM		10/21/03

Distribution:

Registered Professional Engineer's Stamp (if required)

PROBLEM STATEMENT:

TSF-26 Site Remediation Operations require the removal of the waste lines feeding and the residual waste in the PM2A Tanks [V-13 (East Tank) and V-14 (West Tank)]. The waste would include the materials generated during Field Sampling and Equipment Decontamination Operations.

Another Issue is the Volume of the PM2A Tanks themselves and their "Disposal" at the ICDF.

A change from previous Revision 1 of this EDF is the additional removal of the Waste Piping under Snake Avenue.

Another change from previous Revision 1 of this EDF is the deletion of the Waste Debris and Water from the Decontamination efforts associated with the Concrete Cradle Sampling Operations.

Another change from previous Revision 1 of this EDF is the addition of the Waste Debris from the Decontamination efforts associated with the Support Equipment and Ancillary Systems - RUBB Enclosures, Vacuum System, etc.

ASSUMPTIONS:

The Assumptions utilized in the performance of these calculations are outlined below:

- Only 3.0% of the PM2A Mass Excavation is considered "Contaminated" and must be packaged in Roll-Off Containers with "Burrito Bag Liners" [Conclusion from soil sampling radiological survey data - accomplished in May 2003 by BBWI]
- PM2A Tank Volumes based upon values sited in EGG-2236 FINAL Report D&D of TAN PM-2A System, March 1983 / Figure 2-9
- Sampling and Equipment Decontamination Waste Debris and Decon Water generation rates based upon previous D&D Engineering Experience and are stated in attached Excel Spreadsheets

REFERENCES:

EGG-2236 FINAL Report D&D of TAN PM-2A System, March 1983 / Figure 2-9

CALCULATIONS / ANALYSIS:

See Attached Excel Spreadsheet Calculations based upon PM2A Site Physical Configuration and above stated considerations for waste quantity development.

Intrepid technology & resources incorporated

NEEL BBWI RFP-394 RD/RA Work Plan for WAG 1-10 ==> PM2A Tanks - Waste Quantities Calculations

WAG 1-10 Sites TSF-26, TSF-03, and WRRTF-01

Waste Management Plan - "DRAFT" FINAL Design

Checked 90% Design - 17-May-03, DJ Kenoyer, Verified by Lynn Higgins
Checked 100% Design - 15-Jun-03, DJ Kenoyer, Verified by Lynn Higgins
Updated 100% Design - 23-Jul-03, DJ Kenoyer, PM2A Tank Volumes - Verified by Lynn Higgins
Updated "DRAFT" FINAL Design - 16-Oct-03, DJ Kenoyer, PM2A Tank Volumes - Verified by Lynn Higgins

Table 3-1. Waste stream summary for the PM2A Tanks

Remedial Action Activity	*Waste Description*	*Location*	*Expected Type and Applicable Waste Codes*	*Estimated Volume*	*Planned DOT Class Packaging*	*Storage Location*	*Planned Treatment/Disposal*
Excavate soil above and around the tanks	Soil	PM2A Tanks AOC	MLLW F001	***164*** cubic yards	Class 7 LSA Soil bags in roll-off containers	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Contaminated Soil	*each*	*width*	*length*	*depth*	*volume (cubic feet)*	*volume (cubic yards)*
PM2A Tank Excavation Area	1	59	85	16		
	1	91	117		125,296	4,640.6
PM2A Tank Ramp	1	12	96	16		
	1	40	96		19,940	738.5
	each	*diameter (feet)*	*length*	*exposed*		
PM2A Tanks	2	12.5	55.0	0.5	(6,749.5)	(250.0)
PM2A Tank Manhole Access	2	5.5	12.0	1.0	(570.2)	(21.1)
					137,916	5,108.0
				Soil Expansion Factor ==>	7.0%	357.6
						5,465.6
	Assumed Percentage of PM2A Soil Excavation of Radiologically Contaminated Soils					
				Assumed Percentage ==>	3.0%	164.0

Remove and size associated PM2A Tanks [V-13, V-14]	Empty Waste Tanks	PM2A Tanks AOC	MLLW F001	***165*** cubic feet MINIMUM Volume	Class 7 LSA 18 ounce Vinyl Laminate - Yellow	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Waste Lines	*each*	*diameter (feet)*	*length*	*thickness (inches)*	*volume (cubic feet)*		*Half Tank Volumes*
13 / V-14	2	12.5	55.0		13,499.0	Total Tank Volume	6,749.51
Miscellaneous Items - Reinforcing Ribs, Hatchways, etc.					944.9	7.0%	472.47
PM2A Tank Manhole Access	2	5.5	16.0		760.3	Total PM2A Tank Manhole Access	380.13
					15,204.2	MAXIMUM Volume	7,602.1
				30%	4,561.3	Typical Volume Reduction - Waste Minimization	2,280.63
V-13 / V-14	2	12.50	55.00	0.1875	71.3	Total Tank Material Volume - MINIMUM Volume	
Miscellaneous Items - Reinforcing Ribs, Hatchways, etc					5.0	7.0%	
PM2A Tank Manhole Access	2	5.50	16.00	0.1250	6.3	Total Manhole Access Material Volume - MINIMUM Volume	
					82.6	MINIMUM Volume	
				100%	165.2	Typical Waste Minimization Volume	

Remove and size associated waste lines; verify lines are empty	Empty piping	PM2A Tanks AOC	MLLW F001	***39*** cubic feet	Class 7 LSA Metal drums/boxes or wooden waste	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Waste Lines	*each*	*diameter (inches)*	*length*		*volume (cubic feet)*	
V-13 (East Tank / Tk-710) Main Waste Line from TAN-	1	4	112	To Snake Avenue Plus Depth to Tank	9.8	Not Added in Subtotals Previously
V-13 Under Snake Avenue & "T"	1	4	35	25'0" Snake Ave / 10'0" to "T" Flange	3.1	
V-13 Fill Lines from PM2A	3	4	10		2.6	
V-13 Fill Vent Line	1	6	15		2.9	
V-14 (West Tank / Tk-709) Main Waste Line from TAN-	1	4	139	To Snake Avenue Plus Depth to Tank	12.1	
V-14 Under Snake Avenue & "T"	1	4	35	25'0" Snake Ave / 10'0" to "T" Flange	3.1	
V-14 Fill Lines from PM2A	3	4	10		2.6	
V-14 Fill Vent Line	1	6	15		2.9	
					39.1	

move tank contents	Sludge and diatomaceous earth	Inside PM-2A Tanks	MLLW F001	***6,020*** gallons	Class 7A, Type A Metal drums/boxes	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

TPM2A Tank Contents	*Sludge*	*depth (inches) (h)*	*length*	*diameter*	*volume (cubic feet)*	
V-13 (East Tank / Tk-710) Waste Depth	6" Brown Sludge / 6" Black Sludge / 12" Liquid	24.00	55	12.5	696.1	per the EGG-2236 FINAL Report D&D of TAN PM-2A System, March 1983 / Figure 2-9. Liquid and Sludge Depths in PM-2A Tanks, measured in 1981
	s ==>	109.98	A ==>	1,822.56		A=h/6s(3h2+4s2) s=sqrt(8h(r-h/2))

	6" Brown Sludge / 0" Black Sludge / 1.5" Liquid	13.50	55	12.5	**300.6**	2,997	gallons removed - EGG-2236 page 22	
	s ⟹	85.85	A ⟹	787.02				
Diatomaceous Earth ADDED EGG-2236, page 22	*number of bags* 196	*pounds per bag* 50.0	*pounds per cubic foot* 46.0		**213.0**			
V-14 (West Tank / Tk-709) Waste Depth	4" Sludge / 18" Liquid	22.00	55	12.5	**613.7**			
	s ⟹	106.13	A ⟹	1,606.77				
	4" Sludge / 1" Liquid	5.00	55	12.5	**69.0**			
	s ⟹	53.85	A ⟹	180.67				
Diatomaceous Earth ADDED EGG-2236, page 22	*number of bags* 204	*pounds per bag* 50.0	*pounds per cubic foot* 46.0		**221.7**	7.48052	gallons per cubic foot	
					804.4	6,017.2	gallons	
Decontaminate Support Equipment and Ancillary Systems - RUBB Structures, HEPAs, hoses, etc.	**Debris (e.g., PPE, tools, rags, etc.)**	**PM2A Tanks AOC**	**MLLW F001**	*539* **cubic feet**	**Class 7 LSA Metal drums/boxes or wooden waste boxes**	**CERCLA WSA**	**Assume waste meets LDRs; no treatment required ICDF**	
Support Equipment and Ancillary Systems Decon Debris		*days*	*cubic feet per unit*	*units*	*cubic feet*			
PPEs - 4 FTE Decon Crew with 2 Changeouts per day - Large RUBB Enclosure		5	4.5	8	180.0			
Rags and Other Disposible Items		4	1.0	4	16.0			
PPEs - 4 FTE Decon Crew with 2 Changeouts per day - Small RUBB Enclosure		2	4.5	8	72.0			
Rags and Other Disposible Items		2	1.0	4	8.0			
PPEs - 4 FTE Decon Crew with 2 Changeouts per day - Vacuum System Equipment		2	4.5	8	72.0			
Rags and Other Disposable Items		2	1.0	4	8.0			
Remove HEPA Filters and Roughing Filters - Tank		20" x 20" x 6"	2.0	4	8.0			
Remove HEPA Filters and Roughing Filters - Vacuum		20" x 20" x 6"	2.0	4	8.0			
Remove HEPA Hoses - 4" diameter - 10'0"			0.1	100	9.7			
Site Cleanup - Plastic Tarp Berm Liner, Hoses, etc.			150.0	1	150.0			
Decontamination Tools - Brushes, Chisels, etc.			2.0	4	8.0			
					538.7			
Decontaminate Excavation Equipment	Debris (e.g., PPE, tools, rags, etc.)	PM2A Tanks AOC	MLLW F001	*354* cubic feet	Class 7 LSA Metal drums/boxes or wooden waste	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF	
Excavation Equipment Decon Debris		*days*	*cubic feet per unit*	*units*	*cubic feet*			
PPEs - 4 FTE Decon Crew with 2 Changeouts per day		5	4.5	8	180.0			
Rags and Other Disposible Items		4	1.0	4	16.0			
Site Cleanup - Plastic Tarp Berm Liner, Hoses, etc.			150.0	1	150.0			
Decontamination Tools - Brushes, Chisels, etc.			2.0	4	8.0			
					354.0			
Decontaminate excavation and vacuum equipment	Decon water	PM2A Tanks AOC (designated decon area)	MLLW F001	*375* gallons	Class 7 LSA Metal drums	CERCLA WSA	Absorb/solidify free liquid Assume waste meets LDRs; no treatment required ICDF	
Equipment		*days*	*gallons per unit*	*units*	*gallons*			
PPEs - 4 FTE Decon Crew with 2 Changeouts per day		4	-	8	-			
Rags and Other Disposable Items		4	-	4	-			
Equipment - Equipment Washed with High Pressure Low Volume Sprayer - Collected in Wash Off Area (Bermed Area lined with Plastic Tarp - Collected into			25.0	15	375.0			
					375.0			
				393				

AOC area of contamination

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

DOT Department of Transportation

ICDF INEEL CERCLA Disposal Facility

LDR land disposal restrictions

LSA low specific activity

MLLW mixed low-level waste

PPE personal protective equipment

WSA waste storage area

*This volume includes residual waste removed during decontamination of the tank interiors.

Table 3-2. Waste stream summary for TSF-03.

Remedial Action Activity	*Waste Description*	*Location*	*Expected Type and Applicable Waste Codes*	*Estimated Volume*	*Planned DOT Class Packaging*	*Storage Location*	*Planned Treatment/Disposal*
Excavate burn pit area	Soil	TSF-03 AOC	Non-hazardous Pb, dioxins/furans, PCBs, chromium	***804*** cubic yards	Class 7 LSA Soil bags in roll-off containers	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Contaminated Soil	*each*	*width*	*length*	*depth*	*volume (cubic feet)*	*volume (cubic yards)*
Burn Pit		26	64	9	14,976	554.7
Bottom Intrusion		26	64	2	3,328	123.3
Side Intrusion - Sides	2	1	64	11	1,408	52.1
Side Intrusion - Ends	2	1	26	11	572	21.2
					20,284	751.3
				Waste Expansion Factor ⟹	7.0%	52.6
						803.8

Sample soil within the excavation	Debris (e.g., PPE, tools, rags, etc.)	TSF-03 AOC	Non-hazardous Pb, dioxins/furans, PCBs, chromium	***192*** cubic feet	Class 7 LSA Metal drums/boxes or wooden waste	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Sampling Debris	*days*	*cubic feet per unit*	*units*	*cubic feet*
PPEs - 4 FTE Sampling Crew with 2 Changeouts per	4	4.5	8	144.0
Rags and Other Disposable Items	4	1.0	4	16.0
Sampling Tools	4	2.0	4	32.0
				192.0

Sample soil within the excavation	Decon water	TSF-03 AOC	Non-hazardous Pb, dioxins/furans, PCBs, chromium	***32*** gallons	Class 7 LSA Metal drums	CERCLA WSA	Absorb/solidify free liquid Assume waste meets LDRs; no treatment required ICDF

Sampling	*days*	*gallons per unit*	*units*	*gallons*
PPEs - 4 FTE Sampling Crew with 2 Changeouts per	4	-	8	-
Rags and Other Disposable Items	4	-	4	-
Sampling Tools - Tools Rinsed with Dionized Water from Spray Bottle - Collected in Wash Water Container (5-Gallon Plastic Bucket)	4	2.0	4	32.0
				32.0

Decontaminate Excavation Equipment	Debris (e.g., PPE, tools, rags, etc.)	TSF-03 AOC	Non-hazardous Pb, dioxins/furans, PCBs, chromium	***354*** cubic feet	Class 7 LSA Metal drums/boxes or wooden waste	CERCLA WSA	Assume waste meets LDRs; no treatment required ICDF

Excavation Equipment Decon Debris	*days*	*cubic feet per unit*	*units*	*cubic feet*
PPEs - 4 FTE Sampling Crew with 2 Changeouts per	5	4.5	8	180.0
Rags and Other Disposable Items	4	1.0	4	16.0
Site Cleanup - Plastic Tarp Berm Liner, Hoses, etc.		150.0	1	150.0
Decontamination Tools - Brushes, Chisels, etc.		2.0	4	8.0
				354.0

Decontaminate Excavation Equipment	Decon water	TSF-03 AOC (designated decon area)	Non-hazardous Pb, dioxins/furans, PCBs, chromium	***250*** gallons	Class 7 LSA Metal drums	CERCLA WSA	Absorb/solidify free liquid Assume waste meets LDRs; no treatment required ICDF

Equipment	*days*	*gallons per unit*	*units*	*gallons*
PPEs - 4 FTE Sampling Crew with 2 Changeouts per	4	-	8	-
Rags and Other Disposable Items	4	-	4	-
Equipment - Equipment Washed with High Pressure Low Volume Sprayer - Collected in Wash Off Area (Bermed Area lined with Plastic Tarp - Collected into		25.0	10	250.0
				250.0

AOC area of contamination
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
DOT Department of Transportation
ICDF INEEL CERCLA Disposal Facility
LDR land disposal restriction
LSA low specific activity
Pb lead
PCB polychlorinated biphenyl
PPE personal protective equipment
WSA waste storage area

EDF Title: **TSF-26 CRANE LIFTING CALCULATIONS**

Project No.: 2000-096 | Project Title: OU 1-10, TSF-26 REMEDIATION

Project Specific Activity: CRANE LIFTING CALCULATIONS

Problem Statement:

Calculate the weights associated with the PM-2A Tanks (V-13 [East Tank] and V-14 [West Tank]) and RUBB THA Shelter and validate the specified crane lifting capacities to be utilized for crane placement and lifting plans during the Remedial Action Operations. Includes the following breakdown of weights:

- PM2A Tank Half [12'6" diameter x 55'0" length]
- RUBB THA Shelter [26.2' width x 65.0' length] / RUBB Special Shelter [16'0" width x 35'0" length]
- Precast "C" Shape Shielding Concrete [9'10" Sides x 13'10" End x 6'0" Depth x 0'9" Thickness]

The proposed crane to be utilized is a ***GROVE GMK5240*** [Truck Mounted 240-ton Hydraulic Crane] or equal

Summary of Conclusions:

PM2A Tank Site:

- PM2A Tank Half -Weight ==> 32,943 lbs [Steel] and 483 lbs [Tar] ==> 33,425 lbs

[NOTE: Tank wall thickness of 5/8" and Tank ends included in weight calculations ... 7% Contingency covers the access hatch, 4 steel tank reinforcing ribs, and miscellaneous welding reinforcing ... The TAR coating was 1/16" thick]

- RUBB THA - Weight ==> 7,175 lbs
- RUBB Special - Weight ==> 4,500 lbs
- Precast "C" Shape - Weight ==> 22,728 lbs [No longer to be utilized in the Redesign]

The GROVE GMK5240 or equal has sufficient lifting capacity to complete the designated lift for V-13 tank, V-14 tank, and RUBB structures, at the required offset distances from the excavation and not exceed 75% of design capacity. The V-13 and V-14 tanks would be lifted from the East and West sides of the excavation respectively and would be at 63.1% of the crane's lift capacity. There are no lifts tha *would require a "Lift Plan" since the lift does not exceed 80% of the crane lift capacity. This crane access to both sides of the excavation* would require the removal and relocation of the existing West Overhead Power Line at the PM2A Site.

The GROVE TM9120 [INEEL owned truck mounted hydraulic crane] could be utilized at the ICDF to "Off-Load" the PM2A Tank Halves since reach restrictions would not apply and crane could be positioned next to the transport trailer. This would allow the GROVE GMK5240 to stay at TAN and not have to travel to the ICDF for "Off-Loading" Operations.

REVIEW AND APPROVAL SIGNATURES:

	R/A	TYPED NAME/ORGANIZATION	SIGNATURE	DATE
PREPARED BY:		D. J. Kenoyer		12-Dec-03
CHECKED BY:		K. M. SHABER		12/3/03
INDEPENDENT REVIEWER				
APPROVAL:		GARY MECHAM		12/3/03

Distribution:

Registered Professional Engineer's Stamp (if required)

PROBLEM STATEMENT:

TSF-26 Site Remediation Operations require the removal of the waste PM2A Tanks [V-13 (East Tank) and V-14 (West Tank)] and the placement of a temporary enclosure structure [RUBB THA Shelter]. The weight of these items was calculated and the GROVE GMK5240 [240 ton crane] and GROVE GMK6350 [350 ton crane] Technical Manuals consulted to ensure these items could be handled during the Remedial Action Operations.

The placement / positioning of the GROVE GMK5240 and/or GMK6350 crane is critical in relationship to the edge of the excavation to ensure there is no failure of soil stability in that area.

ASSUMPTIONS:

The Assumptions utilized in the performance of these calculations are outlined below:

- Thickness of the PM2A Tank walls to be 5/8"
- Additional weight of reinforcing ribs, access hatch, and other flanges, etc. is equal to 7.0% of above weight
- Thickness of PM2A Tank Exterior TAR Coating was confirmed to be 1/16" and NOT the previously reported 1'2" to 1" thickness range.
- Lifting Capabilities of GROVE GMK5240 based upon Guide Chart
- Weight calculations of RUBB THA Shelter based upon General Specification, Subsection 1.1
- Precast "C" Shape Concrete Shielding unit weight is 145 lbs per cubic foot and the Steel Reinforcing is 4.5% of the concrete weight

REFERENCES:

GROVE GMK5240 Lifting / Crane Capabilities Guide Chart, page 6
GROVE GMK6350 Lifting / Crane Capabilities Guide Chart, page 7
RUBB THA Shelter General Specification, Subsection 1.1, Weight
RUBB Special Shelter, Weight Calculations from Technical Representative Teleconference
Precast "C" Shape Concrete Shielding, weight calculations from Drawing D-4

CALCULATIONS / ANALYSIS:

See Attached Excel Spreadsheet Calculations based upon PM2A Site Physical Configuration and above stated considerations for weight and crane lift capacity development.

The GROVE GMK5240 or equal could handle all lifts of the V-13 and V-14 tanks IF the crane is positioned East and West of the excavation and tanks themselves respectively such that the horizontal distance is limited to 80 feet. This positioning of the crane would result in the V-13 / V-14 tank lifts being at 63.1% of the crane lift capacity. This would require the removal and relocation of the existing overhead electrical line on the West side of the PM2A Tank Site [provides power to pumps at West Lift Station of the Sanitary Sewer Facility].

If lifts were to be completed for the V-13 / V-14 tanks only utilizing access from one side of the excavation, the GMK5240 would be performing the far lift at 92.8% of the crane capacity which is a "Critical Lift" and not advisable from equipment operability. If lifts were to be done from one side of the excavation, a larger crane, GROVE GMK6350 (350 ton) or equal could handle the far V-14 tank lift and would only at 72.7% of the crane lift capacity, a "Non-Critical Lift".

INEEL BBWI RFP-394 RD/RA Work Plan for WAG 1-10 ==> Crane Lifting / Loading Calculations

WAG 1-10 Sites TSF-26, TSF-03, and WRRTF-01

intrepid technology & resources incorporated

INTREPID prepared Revision 0 dated - 13-Jan-2003, by DJ Kenoyer, Checked by SD Dustin

1 *Revision 1, 24-Feb-03, by DJ Kenoyer*

2 *Revision 2, 15-Jul-03, by DJ Kenoyer*

3 *100% Rev 1, 28-Jul-03, by DJ Kenoyer / Changed Tank Thickness to be MORE Conservative to 1/4" from 3/16"*

4 *Draft FINAL, 29-Sep-03 by DJ Kenoyer / Changed Tank Thickness from 1/4" to the 1/2" found during September 2003 Tank Sampling efforts by BBWI*

5 *07-Nov-03 by DJ Kenoyer / Tank Exterior Tar Coating Thickness from 1/2" to 1" found during September 2003 Tank Sampling efforts by BBWI*

6 *20-Nov-03 by DJ Kenoyer / Tank Exterior Tar Coating Thickness 1/16" confirmed by BBWI ==> NOT 1/2" to 1" as reported earlier*

7 *01-Dec-03 by DJ Kenoyer / Tank Steel thickness 5/8" confirmed by BBWI ==> NOT 1/2" as reported earlier [Revision 4]*

Original Configuration

Description	*diameter (lineal feet)*	*length*	*depth*	*Area (square feet)*	*Thickness (inches)*	*Unit (lbs/sf)*	*Weight Tank (lbs)*	*Added (lbs)*	*Total (lbs)*	*Half-PM2A (lbs)*	
Weight Calculations											
7			*CONFIRMED Thickness ==>*		5/8	25.60	61,575	4,310	65,885	32,943	7
7 Specific Weight of "TAR"	72 lbs per cubic foot				0.06	0.38	902	63	965	483	6
								Revised Weight ==>		*33,425*	7 & 6
					1/2	20.40	49,068	3,435	52,502	26,251	4
Specific Weight of "TAR"	72 lbs per cubic foot				0.06	0.38	902	63	965	483	6
										26,734	4 & 6
PM2A Tank	12.5	55.0		2,405.3	3/8	15.30	36,801	2,576	39,377	19,688	
					5/16	12.80	30,788	2,155	32,943	16,471	
Assume Tank Ribs and Manways ==>	7.0%	Added Weight			1/4	10.20	24,534	1,717	26,251	13,126	3
					3/16	7.65	18,400	1,288	19,688	9,844	
					1/8	5.10	12,267	859	13,126	6,563	

Description	*width (lineal feet)*	*length (lineal feet)*	*height (lineal feet)*	*Length (lineal feet)*	*Width (lineal feet)*	*Weight Unit (lbs/lf)*	*THA (lbs)*	*Added (lbs)*	*Total (lbs)*
2 **Weight Calculations for RUBB THA Shelter**									
THA 8 Meter	26.2	65.0		40.0	26.2		5,050		5,050
				25.0		71.00		1,775	1,775
			Percentage Contingency for Added Weight Associated with Lifting System ==>					5.0%	350
									7,175
2 **Weight Calculations for RUBB Special Shelter**									
THA 22'0" Walls	16.0	35.0		35.0	16.0	8.0	4,480		4,500
			Percentage Contingency for Added Weight Associated with Lifting System ==>					5.0%	230
									4,730

Description	*width (lineal feet)*	*length (lineal feet)*	*thickness (lineal feet)*	*Volume (cubic feet)*	*Weight Unit (lbs/cf)*	*Precast (lbs)*	*Added (lbs)*	*Total (lbs)*
2 **Weight Calculations for Precast "C" Section Shielding Concrete**								
Sides	2	6.0	9.8	0.75	87.8	145.0	12,724	12,724
End	1	6.0	13.8	0.75	62.2	145.0	9,024	9,024
				Percentage Contingency for Added Steel Reinforcing ==>			4.5%	980
								22,728

Technical Specifications for Grove Mobile Hydraulic Crane GMK5240 [240 ton crane]

Boom Extension (ft-lineal feet)	*Boom Distance (ft-lineal feet)*	*Boom Angle (degrees)*	*Lift Capacity (lbs)*	*Whole Tank* 52,502 *(lbs)* Percent Lift Capacity	*Half Tank* 26,251 *(lbs)* *26,734* 4 & 6 Percent Lift Capacity
105.0	**80.0**	40.4	53,000	99.1%	49.5%
105.0	**90.0**	31.0	45,000	116.7%	58.3%
121.0	**100.0**	34.3	36,000	145.8%	72.9%
136.0	**110.0**	36.0	32,200		
151.0	**120.0**	37.4	24,800		

Distance from C/L Crane to C/L of Load ===> (h-lineal feet)

4 TANK Steel Plating Thickness REPORTED to be 1/2"

Grove GMK5240 - Hydraulic Truck Crane	240 ton					*Horizontal Distance - Crane to Tank*		*Lift Capacity*	*Percent Loading*
Gross Vehicle Weight	133,900 pounds		V-13	East Tank	80.0	h-lineal feet		53,000	49.5% 4
Maximum Counterweights	154,300 pounds				90.0	h-lineal feet		45,000	58.3% 4
Outrigger Status - Extensions	100% 27'3" Spread		V-14	West Tank	100.0	h-lineal feet		36,000	72.9% 4
Crane Rotation Status	360 degrees		RUBB THA	26.2' x 65.0'	110.0	h-lineal feet	7,175	32,200	22.3% 4
			Precast "C" Shape		110.0	h-lineal feet	22,728	32,200	70.6%

Long High Capacity Trailers Available ==> 2003 Fontaine Specialized TDFT Telescopic Step, Drop Deck Extendable
102" wide / 48'-69' deck / 80,000 lbs capacity

6 TAR Coating Thickness CONFIRMED to be 1/16"

						Horizontal Distance - Crane to Tank		*Lift Capacity*	*Percent Loading*
		V-13	East Tank	80.0	h-lineal feet		53,000	50.4% 4 & 6
				90.0	h-lineal feet		45,000	59.4% 4 & 6
		V-14	West Tank	100.0	h-lineal feet		36,000	74.3% 4 & 6
		RUBB THA	26.2' x 65.0'	110.0	h-lineal feet	7,175	32,200	22.3%
		Precast "C" Shape		110.0	h-lineal feet	22,728	32,200	70.6%

7 TANK Steel Plating Thickness CONFIRMED to be 5/8"

Revised Crane Lift Capacity Loading ===>

						Horizontal Distance - Crane to Tank		*Lift Capacity*	*Percent Loading*
		V-13	East Tank	80.0	h-lineal feet		53,000	63.1% 7 & 6
				90.0	h-lineal feet		45,000	74.3% 7 & 6
		V-14	West Tank	100.0	h-lineal feet		36,000	92.8% 7 & 6
		RUBB THA	26.2' x 65.0'	110.0	h-lineal feet	7,175	32,200	22.3%
		Precast "C" Shape		110.0	h-lineal feet	22,728	32,200	70.6%

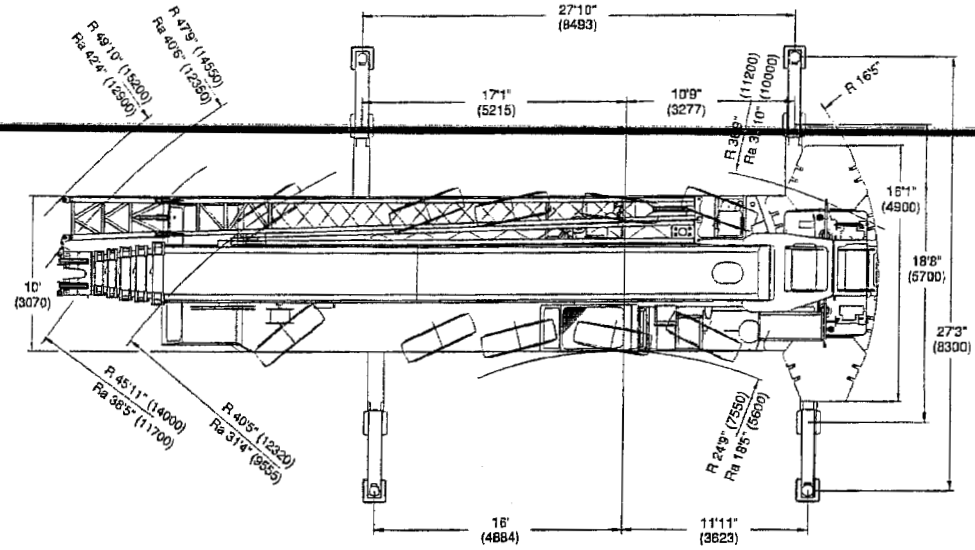
Technical Specifications for Grove Mobile Hydraulic Crane GMK6350 [350 ton crane]

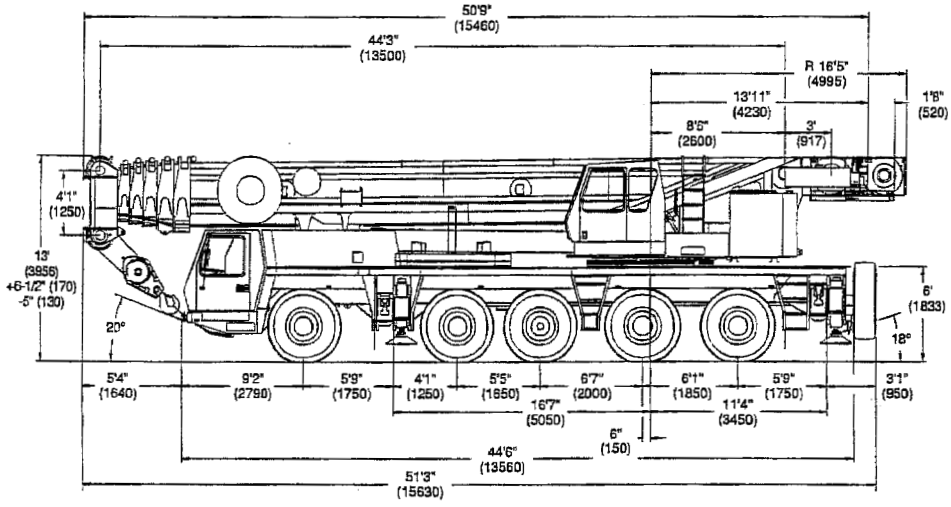
Boom Extension (h-lineal feet)	*Boom Distance (h-lineal feet)*	*Boom Angle (degrees)*	*Lift Capacity (lbs)*	*Whole Tank* 66,851 *(lbs)* Percent Lift Capacity	*Half Tank* 33,425 *(lbs)* Percent Lift Capacity	
106.0	90.0	31.9	62,000	107.8%	53.9%	
124.0	100.0	36.2	51,000	131.1%	65.5%	
142.0	110.0	39.2	46,000	145.3%	72.7%	
151.0	120.0	37.4	40,600	164.7%	82.3%	

Distance from C/L Crane to C/L of Load ===> (h-lineal feet)

Grove GMK6350 - Hydraulic Truck Crane	350 ton						*Horizontal Distance - Crane to Tank*		*Lift Capacity*	*Percent Loading*
Gross Vehicle Weight	158,730 pounds	18.5% Delta		V-13	East Tank	90.0	h-lineal feet		62,000	53.9% 7 & 6
Maximum Counterweights	220,400 pounds	42.8% Delta		V-14	West Tank	110.0	h-lineal feet		46,000	72.7% 7 & 6
Outrigger Status - Extensions	100% 28'6" Spread	61.4% Delta Total		RUBB THA	26.2' x 65.0'	110.0	h-lineal feet	7,175	46,000	15.6%
Crane Rotation Status	360 degrees			Precast "C" Shape		110.0	h-lineal feet	22,728	46,000	49.4%

Dimensions





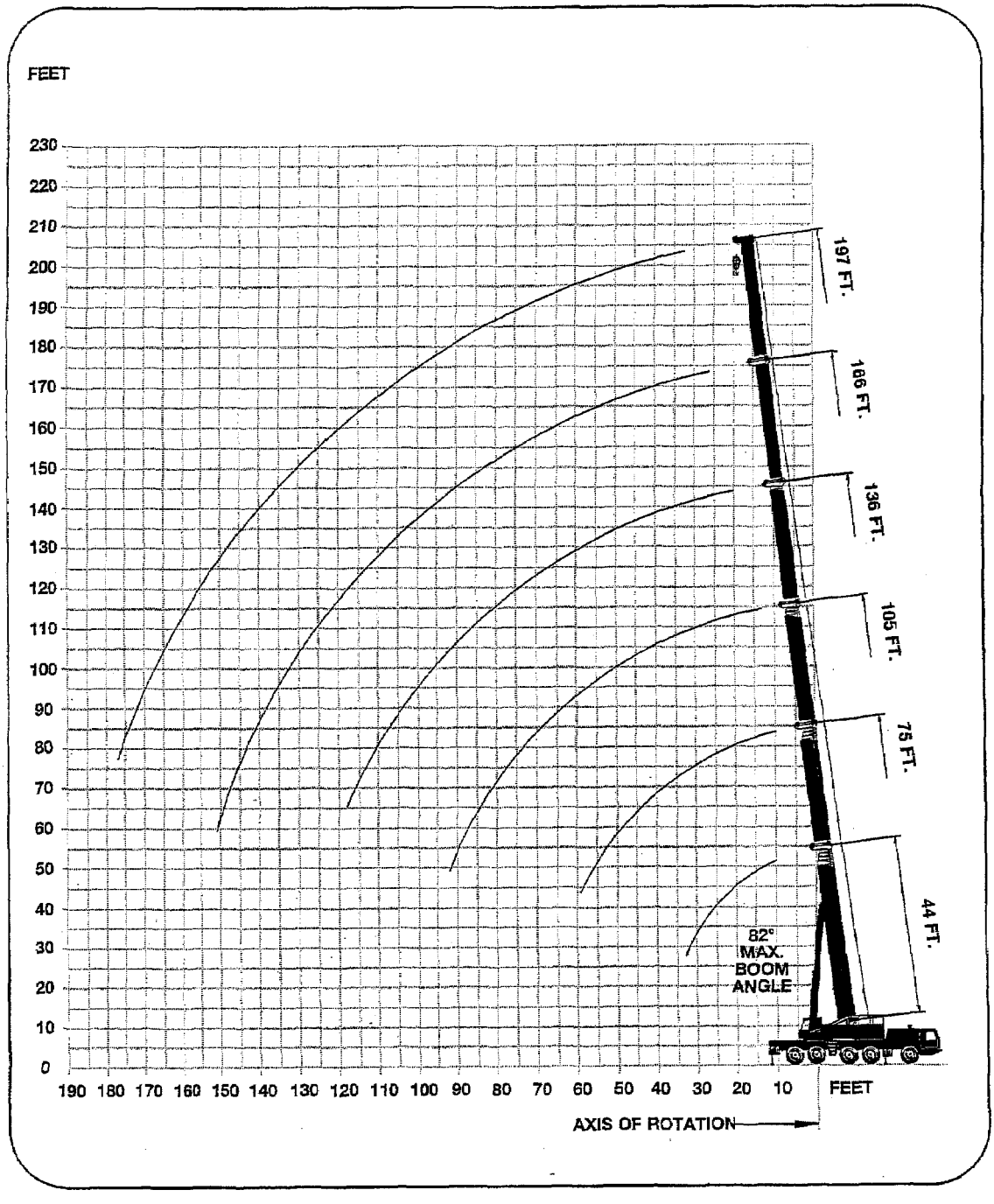
Note: ( ) Reference dimensions in mm

BASIC WEIGHTS (LBS.)	Axles 1 - 3	Axles 4 & 5	Total
With Cummins Power, 10x8x10, 20.5 R25 Tires	82,573	51,609	134,182
With Mercedes Power, 10x8x10, 20.5 R25 Tires	80,637	52,663	133,300
Additions:			
Outrigger Pads	97	212	309
Auxiliary Hoist	-(3,340)	7,066	3,726
Brackets & Hydraulic Reeling Drum for Lattice Extension	703	-(196)	507
Lattice Extension - 43/72 ft	6,969	-(1,502)	5,467
Spare Tire - 14.00 R25 (including stowage bracket)	-(395)	979	584
Spare Tire - 16.00 R25 (including stowage bracket)	-(485)	1,202	717
Spare Tire - 20.5 R25 (including stowage bracket)	-(553)	1,362	809
Removal:			
Front Outrigger Beams & Jacks	-(5,315)	730	-(4,585)
Rear Outrigger Beams & Jacks	2,992	-(8,614)	-(5,622)
Boom Assembly (minus lift cylinder)*	-(41,678)	-(3,230)	-(44,908)
Lift Cylinder*	-(3,404)	-(1,071)	-(4,475)
10x6x10 in lieu of 10x8x10	-(1,296)	436	-(860)
16.00 R25 Tires in lieu of 20.5	-(556)	-(370)	-(926)
14.00 R25 Tires in lieu of 20.5	-(1,349)	-(900)	-(2,249)

*Reflects weights with superstructure facing forward

Working Range

44 - 197 ft. (13.5 - 60 m)	154,300 lbs. (70,000 kg)	100%	360°




44 - 197 ft.
(13.5 - 60.0 m)


154,300 lbs.
(70,000 kg)


100%
27' 3" Spread


360°


Pounds (thousands)

Feet	44*	44	60	75	90	105	121	136	151	166	182	197
8	480.0											
9	416.0											
10	384.0	338.0	336.0	260.0	189.0							
15	306.0	264.0	266.0	260.0	189.0	153.0						
20	252.0	212.0	214.0	211.0	189.0	153.0	123.0	96.0				
25	209.0	177.0	179.0	175.0	177.0	153.0	123.0	96.0	75.0			
30	169.0	150.0	152.0	149.0	151.0	146.0	123.0	96.0	75.0	60.0	47.0	
35			132.0	128.0	130.0	133.0	116.0	92.0	75.0	60.0	47.0	40.0
40			117.0	112.0	114.0	116.0	107.0	85.0	75.0	60.0	47.0	40.0
45			104.0	99.0	102.0	103.0	99.0	79.0	71.0	60.0	47.0	40.0
50				88.0	94.0	92.0	93.0	74.0	66.0	57.0	47.0	40.0
55				79.0	85.0	83.0	85.0	69.0	62.0	54.0	47.0	40.0
60					77.0	75.0	77.0	64.0	58.0	51.0	45.0	40.0
65					70.0	68.0	71.0	58.0	53.0	48.0	42.6	39.0
70					63.0	63.0	63.0	55.0	50.0	45.0	40.6	37.4
75					57.0	59.0	57.0	52.0	48.0	43.2	38.8	35.8
80						53.0	52.0	49.0	45.0	40.8	36.8	34.2
85						49.0	47.0	45.0	41.8	38.4	35.0	32.6
90						45.0	43.0	41.2	39.0	36.2	33.0	30.8
95							39.2	38.8	36.2	33.8	31.0	29.2
100							36.0	36.8	33.6	31.6	29.4	27.6
105								34.8	31.2	30.0	28.0	26.4
110								32.2	28.6	28.4	26.6	25.2
115								29.8	26.2	26.6	25.2	23.8
120									24.8	24.6	23.8	22.6
125									23.6	22.6	22.6	21.4
130									22.4	20.8	21.2	20.0
135									21.8	19.2	20.2	19.2
140										18.4	18.6	18.4
145										17.8	17.2	17.8
150										17.2	16.0	17.0
155											14.8	15.8
160											14.0	14.6
165												13.6
170												12.6
175												11.8
180												10.8

* Over rear only, 27'10" x 18'8" outrigger base.
Lifting capacities greater than 350,000 lbs (160,000 kg) require additional equipment.


44 - 197 ft.
(13.5 - 60.0 m)


97,000 lbs.
(44,000 kg)


100%
27' 3" Spread


360°

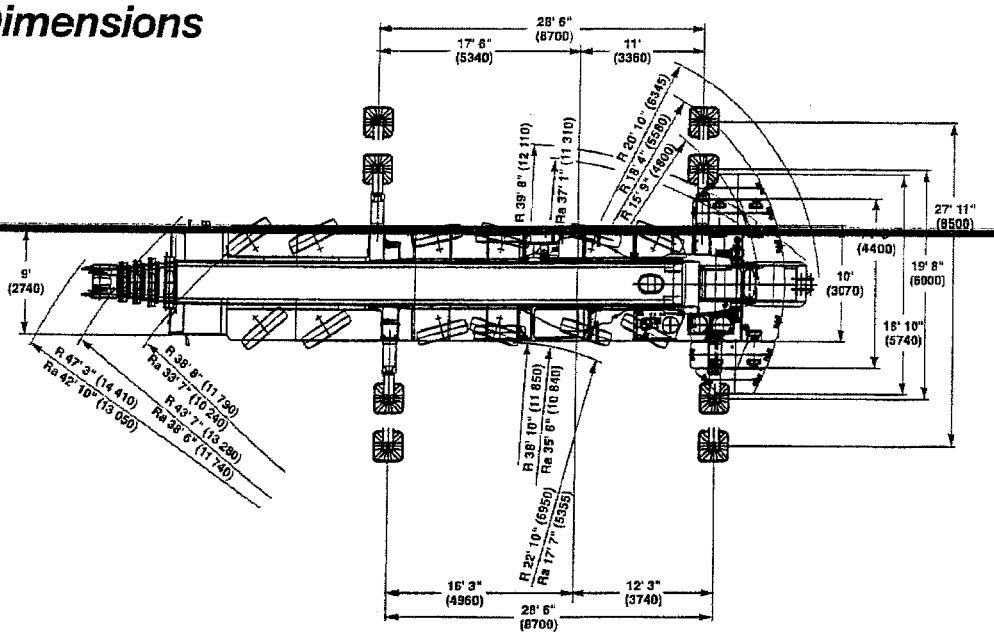

Pounds (thousands)

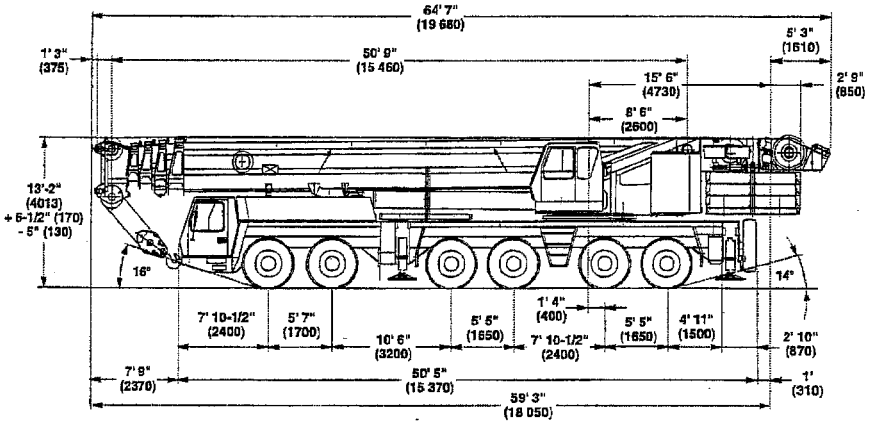
Feet	44*	44	60	75	90	105	121	136	151	166	182	197
8	440.0											
9	416.0											
10	384.0	326.0	326.0	260.0	189.0							
15	306.0	252.0	254.0	252.0	189.0	153.0						
20	252.0	203.0	205.0	202.0	189.0	153.0	123.0	96.0				
25	196.0	170.0	171.0	168.0	170.0	153.0	123.0	96.0	75.0			
30	156.0	144.0	146.0	142.0	144.0	146.0	123.0	96.0	75.0	60.0	47.0	
35			127.0	121.0	124.0	123.0	116.0	92.0	75.0	60.0	47.0	40.0
40			106.0	100.0	106.0	103.0	102.0	85.0	75.0	60.0	47.0	40.0
45			86.0	82.0	89.0	92.0	88.0	79.0	71.0	60.0	47.0	40.0
50				70.0	77.0	78.0	76.0	72.0	66.0	57.0	47.0	40.0
55				64.0	68.0	67.0	65.0	63.0	61.0	54.0	47.0	40.0
60					59.0	58.0	57.0	56.0	54.0	51.0	45.0	40.0
65					52.0	51.0	50.0	52.0	48.0	47.0	42.6	39.0
70					46.0	46.0	46.0	46.0	42.2	42.2	40.6	37.4
75					41.6	40.6	42.6	41.0	38.0	37.8	38.4	35.8
80						36.6	38.4	36.8	36.2	33.8	34.8	34.2
85						34.2	34.8	33.0	34.0	32.0	31.4	32.2
90						32.6	31.6	30.0	30.6	30.2	29.6	29.0
95							28.6	28.2	28.0	28.2	27.6	26.2
100							26.2	26.8	25.4	25.6	25.0	23.6
105								24.8	23.6	23.4	22.8	21.4
110								22.8	22.4	21.6	20.8	19.4
115								21.0	21.0	19.8	19.0	17.6
120									19.4	18.2	17.2	15.8
125									17.8	16.6	15.8	14.4
130									14.8	15.2	14.4	13.0
135									15.2	14.0	13.0	11.6
140										12.8	12.0	10.6
145										11.8	10.8	9.4
150										10.8	9.8	8.4
155											9.0	7.6
160											8.0	6.6
165												5.8
170												5.2
175												4.4
180												3.8

* Over rear only, 27'10" x 18'8" outrigger base.
Lifting capacities greater than 350,000 lbs (160,000 kg) require additional equipment.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE. The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

Dimensions





Note: ( ) Reference dimensions in mm

BASIC WEIGHTS (LBS.)	Axles 1 & 2	Axles 3 - 6	Total
With Cummins Power, 12x6, 20.5 R25 Tires, 2nd Hydraulic Oil Cooler, Brackets for swingaway	51,347	108,241	159,588
Mercedes Power	-(361)	-(344)	-(705)
Additions:			
12 x 8 x 12 in lieu	965	-(105)	860
Outrigger Pads	-	772	772
Removable rear outrigger box option (Cummins eng)	-(1,225)	3,430	2,205
Auxiliary Hoist	-(5,365)	11,450	6,085
Swingaway	6,860	-(1,525)	5,335
Spare Wheel 20.5 with stowage	-(590)	1,400	810
Spare Wheel 16.00 with stowage	-(520)	1,240	720
Spare Wheel 14.00 with stowage	-(425)	1,010	585
Fixed MEGALIFT brackets w/o winch	653 lbs.	-123 lbs.	530 lbs.
Fixed bracket for MEGALIFT winch	119 lbs.	212 lbs.	331 lbs.
Bolted parts for MEGALIFT	119 lbs.	212 lbs.	331 lbs.
MEGALIFT winch	6,257 lbs.	5,736 lbs.	11,993 lbs.
Removal:			
Front Outrigger Beams & Jacks	-(3,380)	-(1,980)	-(5,360)
Rear Outrigger Beams & Jacks	3,730	-(9,650)	-(5,920)
Outrigger Box (must add weight above for option)	6,750	-(17,550)	-(10,800)
Boom Assembly (minus lift cylinder)	-(34,750)	-(23,175)	-(57,925)
Telescope Sections 1-4	-(27,900)	-(15,860)	-(43,760)
Lift Cylinder	-(2,250)	-(3,400)	-(5,650)
16.00 R25 Tires in lieu	-(370)	-(740)	-(1,110)
14.00 R25 Tires in lieu	-(900)	-(1,800)	-(2,700)

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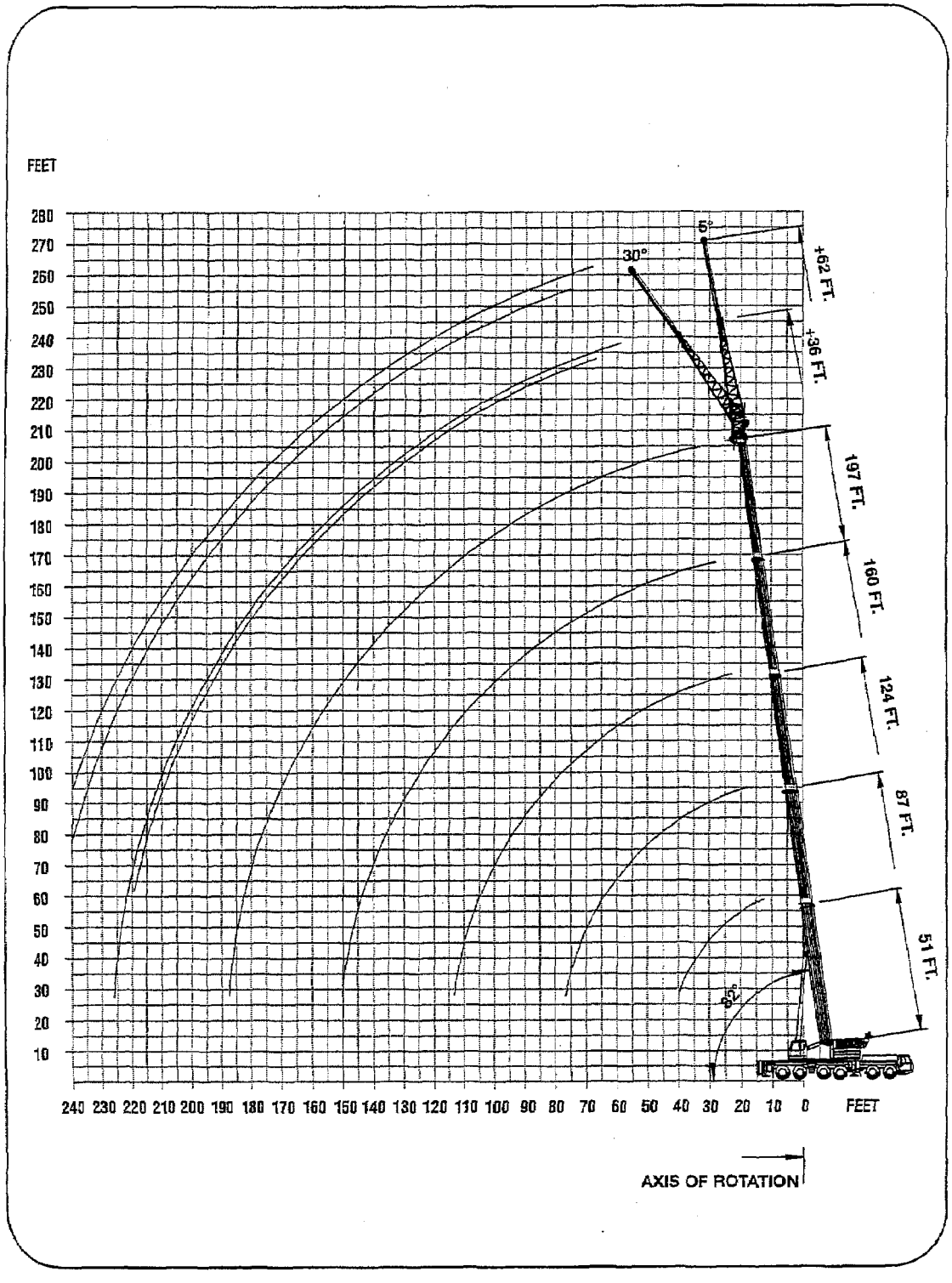
The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

Working range



THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.
The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

51 - 197 ft. (15.5 - 60.0 m) | 220,400 lbs. (100 Tonnes) | 100% 27'11" Spread | 360°

Pounds (thousands)

Feet	51*	51	69	87	106	124	142	160	178	197
8	700.0†									
10	542.0	466.0	422.0	342.0						
15	412.0	370.0	366.0	342.0	242.0					
20	332.0	302.0	302.0	300.0	242.0	185.0	139.0			
25	268.0	254.0	258.0	258.0	242.0	185.0	139.0			
30	219.0	218.0	222.0	222.0	220.0	185.0	139.0	105.0	78.0	66.0
35	185.0	185.0	188.0	188.0	187.0	174.0	137.0	105.0	78.0	66.0
40			162.0	163.0	161.0	161.0	126.0	105.0	78.0	66.0
45			142.0	143.0	141.0	144.0	116.0	102.0	78.0	66.0
50			126.0	126.0	126.0	128.0	106.0	95.0	78.0	66.0
55			113.0	113.0	116.0	114.0	98.0	88.0	78.0	66.0
60				102.0	105.0	103.0	91.0	82.0	75.0	66.0
65				92.0	95.0	93.0	84.0	76.0	70.0	65.0
70				85.0	86.0	85.0	78.0	71.0	66.0	62.0
75					79.0	77.0	73.0	66.0	62.0	59.0
80					72.0	70.0	67.0	62.0	58.0	56.0
85					67.0	65.0	64.0	58.0	54.0	52.0
90					62.0	60.0	61.0	54.0	50.0	49.0
95						55.0	57.0	50.0	47.0	46.0
100						51.0	53.0	48.0	45.0	43.4
105						47.0	50.0	45.0	42.4	41.0
110						45.0	46.0	42.4	40.2	39.0
115							43.2	40.4	38.2	37.0
120							40.6	38.6	36.2	35.2
125								37.0	34.4	33.6
130								34.6	32.6	32.0
135								33.4	31.2	30.0
140								32.4	30.0	27.8
145									28.8	26.0
150									27.2	24.8
155									25.6	23.8
160									24.4	22.6
165										21.6
170										20.6
175										19.2
180										17.2

* Over rear only, 28'8" x 19'6" outrigger base.
Lifting capacities greater than 425,000 lbs require additional equipment.
† 700.00 lbs is a comparative rating

51 - 197 ft. (15.5 - 60.0 m) | 110,200 lbs. (50 Tonnes) | 100% 27'11" Spread | 360°

Pounds (thousands)

Feet	51	69	87	106	124	142	160	178	197
10	446.0	422.0	342.0						
15	352.0	352.0	342.0	242.0					
20	278.0	282.0	282.0	242.0	185.0	139.0			
25	222.0	224.0	224.0	224.0	185.0	139.0	106.0		
30	180.0	183.0	183.0	182.0	182.0	139.0	106.0	78.0	66.0
35	147.0	150.0	151.0	155.0	150.0	137.0	106.0	78.0	66.0
40		129.0	131.0	130.0	126.0	118.0	106.0	78.0	66.0
45		111.0	113.0	112.0	108.0	102.0	97.0	78.0	66.0
50		95.0	97.0	97.0	94.0	94.0	87.0	78.0	66.0
55		81.0	83.0	83.0	82.0	83.0	79.0	73.0	66.0
60			73.0	72.0	75.0	73.0	70.0	68.0	66.0
65			64.0	63.0	66.0	64.0	64.0	63.0	59.0
70			57.0	58.0	58.0	57.0	58.0	56.0	53.0
75				54.0	53.0	52.0	52.0	51.0	48.0
80				48.0	48.0	48.0	47.0	46.0	43.0
85				43.8	42.8	43.6	42.6	41.2	39.0
90				39.6	38.8	39.6	38.4	37.0	35.4
95					36.2	36.0	34.8	33.4	31.8
100					33.0	32.8	31.6	30.2	28.6
105					30.0	29.8	28.8	27.4	25.6
110					27.6	27.4	26.2	24.8	23.2
115						25.0	23.8	22.6	20.8
120						23.0	21.8	20.4	18.8
125							19.8	18.6	16.8
130							18.2	16.8	15.0
135							16.6	15.2	13.4
140							15.0	13.8	12.0
145								12.4	10.6
150								11.2	9.4
155								10.0	8.2
160								9.0	7.0
165									6.0
170									5.0
175									4.2

Lifting capacities greater than 425,000 lbs require additional equipment.
Note: Above chart is available with reduced outriggers.

THIS CHART IS ONLY A GUIDE AND SHOULD NOT BE USED TO OPERATE THE CRANE.
The individual crane's load chart, operating instructions and other instructional plates must be read and understood prior to operating the crane.

INTREPID
Engineering Services, Inc.
A New Type of Engineering Company
501 West Broadway, Suite 200 Idaho Falls, ID 83402
(208) 529-5337

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

TOTAL VOLUME:

$$V_{BS} + V_B + 2V_S = V_T = 288.32\ ft^3$$

$$\rho_{CONCRETE} = 145\ lb/ft^3$$

$$V_T\rho = \boxed{M_T = 41{,}805\ lb = 20.9\ TON}$$

TOTAL WEIGHT WILL BE SLIGHTLY ADJUSTED BY THE PRESENCE OF REINFORCING STEEL IN THE CONCRETE, OR BY THE SPECIFIC MIX USED. THIS IS AN APPROXIMATE WEIGHT.

PRE-CAST SHIELD BLOCK "U" SHAPE

$288.32\ ft^3 - V_{BS}\ (138.33\ ft^3) = 149.99$ USE 150 cf

$\Rightarrow (145\ lb/cf)(150\ cf) = 21{,}750\ lb$ ✓

DNKENOYER
17 OCT 08 @ 1401 MST

INTREPID
Engineering Services, Inc.
A New Type of Engineering Company
501 West Broadway, Suite 200 Idaho Falls, ID 83402
(208) 529-5337

JOB

SHEET NO. OF

CALCULATED BY K. SHABER DATE 10/17/03

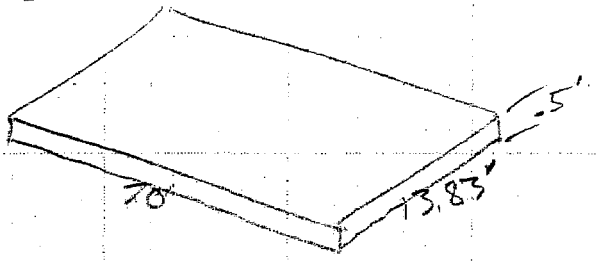
CHECKED BY DATE

SCALE

CONCRETE SHIELD WALL WEIGHT ESTIMATION

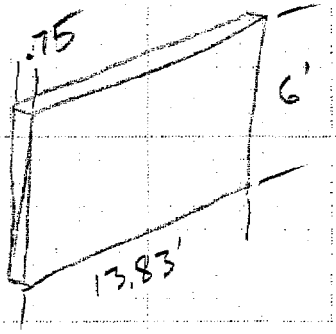
- FROM DRAWING D-4

BASE SLAB:



$\Rightarrow V_{BS} = 138.33\ ft^3$

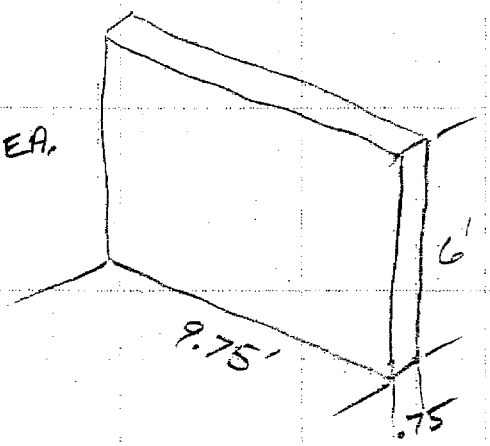
BACK:



$\Rightarrow V_B = 62.24\ ft^3$

SIDES:

REA.



$\Rightarrow V_S = 43.88\ ft^3$

intrepid technology & resources incorporated

ENGINEERING DESIGN FILE

EDF-096- 006
Rev. No. _____

EDF Title: Waste Contents Density Evaluation and Vacuum Selection

Project No.: 2000-096	Project Title: OU 1-10, Group 3

Problem Statement: Select a vacuum extraction system to remove waste from the PM-2A tanks (V-13 and V-14).

Summary of Conclusions: A 75hp diesel engine powered vacuum system rated for 16" w.g. at 1500 cfm will provide sufficient extraction flowrate, extraction force, and nozzle velocity to extract waste sludge from the PM-2A tank wastes.

Review and Approval Signatures:

	R/A	Printed Name	Signature	Date
Prepared by:		Kesley K. Kimmell		10/21/03
Checked by:		KEVIN SHAFER		10/20/03
Approval:		GARY MECHAM		10/21/03

Distribution:

Professional Engineer's Stamp (if required)

ENGINEERING DESIGN FILE

EDF Title: Waste Contents Density Evaluation and Vacuum Selection			EDF- 096-006
Project No.: 2000-096			Rev No.:
Project Title: OU 1-10, Group 3			Page 2 of 2
Prepared by:	Date:	Checked by:	Date:

Problem Statement:
OU 1-10 PM-2A 90% design, technical specification 13121,Vacuum System
EDF-3260

Assumptions:

1) Distance of conveyance is 100 ft.
2) Flowability of tank waste is 75% of soil flowability
3) Moisture content will not cause bridging/jamming of solids hopper
4) Extraction will be done in a homogenous manner
5) Extracted particles will be no larger than 1/3 the diameter of the hose (1.5" – 2")

References:

A) EDF-3260, Table B-3
B) EDF-3260, Table B-2
C) Multi-Vac conveying capacities vs. conveying distance curves
D) Multi-Vac vacuum system specifications
E) MichiganTech Research
F) Crane technical paper 410, Flow of Fluids Through Valves, Fittings and Pipe
G) Multi-Vac nozzle velocities & line sizes

Calculations / Analysis:
See attached pages

1)	**Fill rate**	**Ref**
	Sludge properties given	
(1)	$\rho = 1.35$ kg/L = 84 lb/ft^3 = ρ_{max}	A
(2)	m = 11,446 kg	A
(3)	$V = {}^{m}/_{\rho} = {}^{11,446\ kg}/_{1.35\ kg/L} = 8,479$ L	
	DE & H_2O properties given	
	$\rho = 1.18$ kg/L = 74 lb/ft^3 = ρ_{min}	B
(4)	m = 9,072 kg + 16,930 kg = 26,002 kg	B
(5)	$V = {}^{m}/_{\rho} = {}^{26,002\ kg}/_{1.18\ kg/L} = 22,036$ L	
	Waste properties calculated	
(6)	m = 11,446 kg + 26,002 kg = 37,448 kg	(2) & (4)
(7)	V = 8,479 L + 22,036 L = 30,515 L	(3) & (5)
	$\rho_{ave} = {}^{m}/_{V} = {}^{37,448\ kg}/_{30,515\ L} = 1.23$ kg/L = 77 lb/ft^3	(6) & (7)
Using Multi-Vac curves, for ρ of 51-100 lb/ft^3 (C) and 100 ft. conveyance distance (assumption 1), a 75 hp vacuum system will convey approximately 25 T/hr, or 22,680 kg/hr. At 75% efficiency (assumption 2), actual production rate is:		
(8)	${}^{dm}/_{dt} = \eta^*(25$ T/hr) = 18.75 T/hr = 17,010 kg/hr	Ass. 2
At ρ_{max} (least V/m), ${}^{dV}/_{dt}$ is:		
	${}^{dV}/_{dt} = {}^{dm}/_{dt} / \rho = {}^{17,010\ kg/hr}/_{1.35\ kg/L} = 12,600$ L/hr = 445 ft^3/hr	(1) & (8)
A 35 ft^3 hopper at full extraction rate would fill in <5 minutes. A 100 ft^3 waste box would fill in <15 minutes.		

2)	**Extraction force**	**Ref**
(9)	F = pA where:	
	F = extraction force in lb. p = pressure differential in psi A = cross-sectional area in in^2	
(10)	$\Delta p = 16$" Hg = 7.84 psi	D
(12)	$A = \pi d^2/4$ where:	
	A = cross-sectional area in in^2 d = nozzle diameter in in.	
(13)	d = 5"	D
(14)	$A = \pi d^2/4 = 19.625$ in^2	(12) & (13)
(15)	F = pA = 7.84 psi * 19.625 in^2 = 153.8 lb	(9), (10) & (14)
By inspection, extraction force at the nozzle (12) is almost double that required for 1 ft^3 of pure sludge (1). Since extracted particles will be considerable smaller than 1 ft^3 (<1%) (assumption 5) the extraction force is adequate.		

3)	**Settling velocity**	**Ref**
A particle will reach its settling velocity when the drag force and buoyancy force balance with the gravitational force on the particle:		
(16)	$\Sigma F = F_D + F_B - W = C_D({}^{\pi}/_{8})\rho_g d^2 V^2 + ({}^{\pi}/_{6})d^3\rho_g g - ({}^{\pi}/_{6})d^3\rho_p g$ which is solved for terminal settling velocity as:	E

(17)	$V_{TS} = [(4/3)(\rho_p - \rho_g)(dg)/(\rho_g C_D)]^{1/2}$ where: V_{TS} = terminal settling velocity in ft/sec ρ_p = density of the particle in lb/ft^3 ρ_g = density of the gas in lb/ft^3 d = diameter of the pipe in ft. g = gravitational acceleration in ft/sec^2 C_D = drag coefficient	(16) & E
(18)	$\rho_g = .08$ lb/ft^3	F
(19)	$C_D = 1$ (most conservative)	
(20)	$V_{TS} = [(4/3)(\rho_p - \rho_g)(dg)/(\rho_g C_D)]^{1/2}$ $= [(4/3)(84 - .08)(2/12)(32.2)/(.08 * 1)]^{1/2}$ = 87 ft/sec = 5198 ft/min	(1), (17), (18), Ass. 5, & (19)
(21)	V = 5400 ft/min (nozzle velocity)	G
Since the velocity supplied by the vacuum system (21) is greater than that which allows settling of the particles (20) using the most conservative values for density of the sludge (1) and C_D (20) the velocity for the vacuum system is adequate.		

REF. A

Table B-3. Waste mass determination.

Sludge Mass Calculation			
	Gallons	Density	Kg
V-13	1,870	1.35 g/ml	9,555
V-14	370	1.35	1,891

Diatomeous Earth Mass Conversion			
	Pounds	Conv Factor	Kg
V-13	9,800	0.4536 Kg/lb	4,445
V-14	10,200	0.4536	4,627

Total	Sludge Mass	11,446
	Diatomeous Earth Mass	9,072
	Water in Diatomaceous Earth	16,930
		37448 37450

Table B-4. Curies determination.

Radiological Results	Hi Value Diatom Earth (pCi/g/g)	Curies	Hi Value Sludge (pCi/g/g)	Curies	Total Curies
U-233	150	3.899E-03	1,780	2.037E-02	2.427E-02
U-234	150	3.899E-03	1,860	2.129E-02	2.519E-02
U-235	4.66	1.211E-04	67.8	7.760E-04	8.971E-04
U-236	1	2.599E-05	12.6	1.442E-04	1.702E-04
U-238	1.19	3.093E-05	14.1	1.614E-04	1.923E-04
Pu-238	29.8	7.745E-04	1,710	1.957E-02	2.035E-02
Pu-239	101	2.625E-03	2,140	2.449E-02	2.712E-02
Pu-240	101	2.625E-03	2,140	2.449E-02	2.712E-02
Am-241	18.7	4.860E-04	471	5.391E-03	5.877E-03
Th-228	34.5	8.967E-04	34.5	3.949E-04	1.292E-03
Sr-90	18,900	4.912E-01	4,570,000	5.231E+01	5.280E+01
Co-60	128	3.327E-03	25,200	2.884E-01	2.918E-01
Cs-137	154,000	4.003E+00	1,170,000	1.339E+01	1.739E-01
Eu-154	0	0	6,940	7.943E-02	7.943E-02
Ni-63	10,300	2.677E-01	31,900	3.651E-01	6.328E-01

REF. B

Table B-2. (continued)

Analyte	DE 2CB13201	Sludge 2CB13202
Miscellaneous Results	**mg/kg**	**mg/kg**
Bromide	1.86	0
Chloride	54.4	33.1
Fluoride	0	0
Nitrate	1.76	4
Nitrite	5.93	0
Phosphate	11.9	0
Sulfate	481	371
Total Carbon	**17,100**	**76,100**
Total Halides	**30.3**	**218**
	g/mL	**g/mL**
Density	1.18	0.749
pH	9.36	8.68

[a] The metals for 2CB13201 AND 2CB13202 were changed per reference 6 and that data was switched between the diatomaceous earth and sludge based on the sludge having the higher concentrations of elements.

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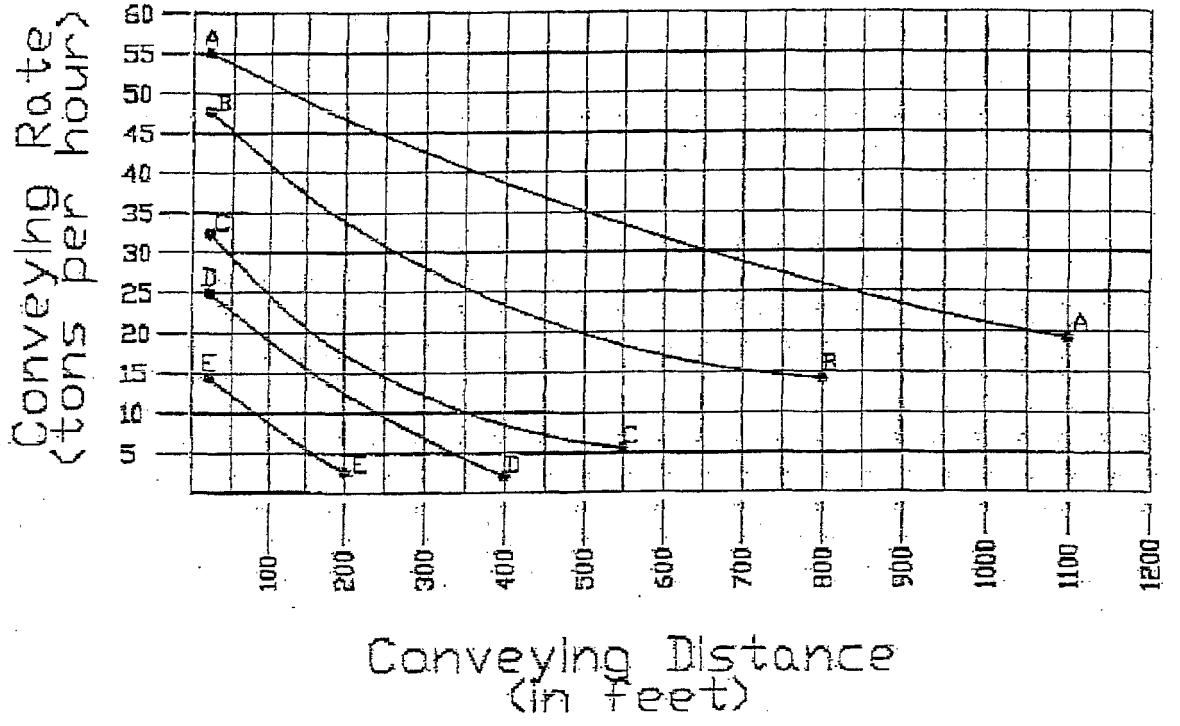
REF. C

Multi-Vac

Conveying Capacities
Model 7500S Diesel Stationary



A = 0-25 LBS per Cu.Ft. Bulk Density of Material
B = 26-50 LBS per Cu.Ft. Bulk Density of Material
C = 51-100 LBS per Cu.Ft. Bulk Density of Material
D = 101-200 LBS per Cu.Ft. Bulk Density of Material
E = 201-300 LBS per Cu.Ft. Bulk Density of Material

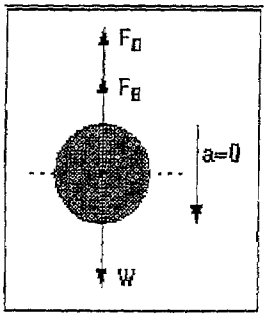
h:\engine\BOM\Multivac\capacities charts\75 hp diesel

REF. 6

Settling Velocity

The terminal settling velocity of an airborne particle is an important quantity for characterizing the settling behavior of the particle. The aerodynamic diameter of a particle, a key property for characterizing particle deposition, is dependent upon the settling velocity.

A particle will reach its settling velocity when the drag force and buoyancy force balance with the gravitational force on the particle.



$$\Sigma F = F_D + F_B - W = C_D \frac{\pi}{8} \rho_G d^2 V^2 + \frac{\pi d^3}{6} \rho_G g - \frac{\pi d^3}{6} \rho_P g = 0$$

Solving for V, the settling velocity is therefore:

$$V_{TS} = \sqrt{\frac{4(\rho_P - \rho_G) d g}{3 \rho_G C_D}}$$

REF. 6

Multi-Vac

NOZZLE VELOCITIES & LINE SIZES FOR SHOT,SAND & FLY ASH

HP	LINE SIZE	NOZZLE VELOCITY	MATERIAL	LBS /CU FT
10	2"	5,825 ft/min	STEEL SHOT	201-300
	2.5"	3,724 ft/min	SAND	51-100
15	2"	7,545 ft/min	STEEL SHOT	201-300
	2.5"	4,809 ft/min	SAND	51-100
	3"	3,346 ft/min	FLY ASH	26-50
20	2.5"	6,040 ft/min	STEEL SHOT	201-300
	3"	4,200 ft/min	SAND	51-100
	3.5"	3,080 ft/min	FLY ASH	26-50
25	3"	5,750 ft/min	STEEL SHOT	201-300
	3.5"	4,220 ft/min	SAND	51-100
	4"	3,240 ft/min	FLY ASH	26-50
30	3"	6,890 ft/min	STEEL SHOT	201-300
	3.5"	5,060 ft/min	SAND	51-100
	4"	3,885 ft/min	FLY ASH	26-50
40	3.5"	6,040 ft/min	STEEL SHOT	201-300
	4"	4,640 ft/min	SAND	51-100
	5"	2,960 ft/min	FLY ASH	26-50
50	4"	6,750 ft/min	STEEL SHOT	201-300
	5"	4,300 ft/min	SAND	51-100
	6"	2,988 ft/min	FLY ASH	26-50
75	4"	8,440 ft/min	STEEL SHOT	201-300
	5"	5,400 ft/min	SAND	51-100
	6"	3,750 ft/min	FLY ASH	26-50
100	5"	8,100 ft/min	STEEL SHOT	201-300
	6"	5,620 ft/min	SAND	51-100
	8"	3,157 ft/min	FLY ASH	26-50

1" Hg = .03332 atm = 70.5867 psf = .489769 psi

16" Hg = .53232 atm = 7.8363 psi

5" ϕ $\Rightarrow$ 19.625 in^2

F = PA = 153.8 lb.

Intrepid technology & resources incorporated

ENGINEERING DESIGN FILE

EDF 096-008
Rev. No. 1
Page 1 of 17

EDF Title: **BROKK 330D SPECIFICATIONS - MANUFACTURERS DATA**

Project No.: 2000-096 | Project Title: OU 1-10, TSF-26 REMEDIATION

Project Specific Activity: BROKK 330D MANUFACTURERS SPECIFICATIONS

Problem Statement:

Need currently manufactured self-contained equipment to perform the D&D and Waste Removal Operations for the PM2A Tanks, TSF-26 Remediation:

- Self-Contained Equipment … No External Power Sources Required
- Remote Capabilities … Electrical Tether or Radio Control Systems
- Multiple Position Arm and End Effectors … Allow many degrees of motion and many different tool attachments

The proposed equipment to be utilized is a BROKK 330D [Track mounted diesel powered remote D&D equipment]

Summary of Conclusions:

TSF-26 Site:

The BROKK 330D has sufficient lifting capacity and range of motion (degrees of movement) to handle the waste removal operations involved with the PM2A Tank TSF-26 Remediation. The BROKK 330D is self-powering with a diesel engine and can be remotely operated with electrical tether or radio control systems. The BROKK 330D is sufficiently small to allow access between tanks and robust enough to handle the waste removal operations physical activities.

REVIEW AND APPROVAL SIGNATURES:

	R/A	TYPED NAME/ORGANIZATION	SIGNATURE	DATE
PREPARED BY:		D. J. Kenoyer		21 OCT 03
CHECKED BY:		KEVIN SHABER		10/20/03
INDEPENDENT REVIEWER		ORB		
APPROVAL:		GARY MECHAM		10/21/03

Distribution:

Registered Professional Engineer's Stamp (if required)

PROBLEM STATEMENT:

TSF-26 Site Remediation Operations require the removal of the waste PM2A Tanks [V-13 (East Tank) and V-14 (West Tank)]. These waste removal operations must be accomplished utilizing robust remote equipment that has many degrees of motion and has multiple end-effectors (tools). The BROKK 330D could handle these waste removal activities during the Remedial Action Operations.

The final configuration of the BROKK 330D with specified end effectors, diesel snorkel exhaust, and video cameras and lighting will be determined during the procurement phase of the project.

ASSUMPTIONS:

The Assumptions utilized in the selection of "Known" D&D type equipment are the following capability criteria:

- Current commercial availability
- Known performance of equipment on other DOE D&D Projects
- Large range for degree of motion for equipment movement
- Multiple end effectors (tools) and availability
- Self-sufficient power source
- Remote operation capabilities

REFERENCES:

BROKK 330D Specifications

CALCULATIONS / ANALYSIS:

None Required

The researcher has previously researched, specified, and utilized other BROKK equipment on DOE D&D Projects [INEEL BROKK 220 being utilized by ER D&D Program]. These BROKK have been well received on all projects and have been instrumental in improved project efficiencies (accomplish work quicker, faster, cheaper) and improved worker safety (reduced exposure to industrial hazards involved in cutting and sizing operations).

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Products
Range of uses
More about Brokk
The company
Printed matters
News and events

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Contacts in Brokk AB

Other Brokk sites:
www.brokkinc.com
www.brickingsolutions.com
www.brokk.es
www.brokk.uk.com

Brokk - remote demolition

Welcome to Brokk, the world's leading supplier of remote controlled demolition robots. Browse our website and find out how Brokk can help you do your job quicker, safer, more economically and a lot more user friendly.

Certified by Lloyds according to ISO 9001.

Brokk remote controlled manipulators

Brokk at Metec 2003

Brokk participatec in Metec in June, the Metallurgical Trade Fair in Düsseldorf, Germany. Brokk has a strong position in the process industry.

Brokk Nuclear is a special business area within the Brokk organization. We have more than ten years' experience from installations in nuclear environments. More info and a project example.

Brokk and Autod collaboration
Autodesk, one of th suppliers of 3D-CA world, recently la release of Autodes 7. They wanted to of a Brokk demoliti the packing - the n here.

Brokk design engin using Autodesk Inv years now and find powerful to work w

Top-down demolition with Brok leading role

When the 9-storey former hospital Sweden is torn down, it's with the use of compact, remot Brokk robots. The demolition contract was delicate as the building were to remain intact, housing as they are gover and a care centre

More about this challenging project.

The Sandö Bridge reconstruction

Four Brokk machines are currently used to remove the entire bridge deck of what was once the world's longest concrete bridge with an arch measuring 264 metres (870 ft). Read about the impressive renovation project and why the demolition contractor, Norrlands Demolering AB, chose

Watch how Brokk f debricking. Click o take a minute to d

Brokk 330

Technical data sheet
Brochure Brokk 330

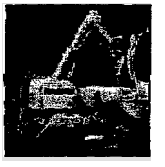
(Click to enlarge the pictures)

The giant in the Brokk family is the 330 model. To our knowledge it is also the most powerful demolition robot available on world markets at present. As with all Brokk machines, the capacity in relation to size and weight is unsurpassed.

In spite of its low weight - Brokk 330 weighs only 4100kg without attachment - it can handle tools of up to 550 kilo weight. Compare these figures with the weight of a normal digger equipped with the same type of breaker! What makes the difference is that a Brokk machine is designed and built specifically for demolition purposes, thus optimised for this particular kind of job. And it does it better than any other equipment available.

Another characteristic of a Brokk robot is that it is electrically powered. It is quiet and environmental friendly as it produces no exhaust fumes. This is especially important when the machine is used for indoor demolition. Although it is our biggest model, Brokk 330 is small enough to negotiate narrow passages.

Examples of uses for the Brokk 330 are demolishing bank vaults, cleaning slag in blast furnaces, major building demolitions, cement kiln demolition and waste handling in the nuclear industry.



Brokk 330:
Height 1540mm
Width 1500mm
Weight 4100kg

Click on Brokk 330 data sheet for more technical information.

Click here to see the Brokk 330 brochure.

Read also: range of uses, accessories

You will need to have Acrobat Reader installed on your computer to view the data sheets and brochures. You can download it free from Acrobat Reader.

Questions about this model? Get in touch with your local Brokk dealer or us directly at info@brokk.com

(SE)

HYDRAULSYSTEM

Pumptyp	Variabel lastkännande kolvpump
Systemtryck standard	16,5 MPa
Flöde	0-100 l/min

ELMOTOR

Effekt	30kW
Varvtal	Se maskinskylt
Spänning/Frekvens	Se maskinskylt
Ström	Se maskinskylt
Startkopplare	Y/D start

STYRSYSTEM

Manöverdon	Bärbar manöverlåda
Signalöverföring	Digital
Överföring	Kabel

(GB)

HYDRAULIC SYSTEM

Type of pump	Variable displacement loadsensing
Pressure	16,5 MPa
Flow	0-100 l/min (0-26 US gal/min)

ELECTRIC MOTOR

Output	30kW
Number of revolutions	See marking
Voltage/Frequency	See marking
Amperage	See marking
Starting device	Y/D starter

CONTROL SYSTEM

Control unit	Remote control box
Signal code	Digital
Control mode	Cable

(DE)

HYDRAULIKANLAGE

Pumpentyp	Variabel, lastabtastende Kolbenpumpe
Arbeitsdruck, Standard	16,5 MPa
Fördermenge	0-100 l/min

ELEKTROMOTOR

Motorleistung	30kW
Drehzahl	Siehe Maschinenschild
Spannung/Frequenz	Siehe Maschinenschild
Strom	Siehe Maschinenschild
Anlasser	Y/D Starter

BEDIENUNGSANLAGE

Steuervorrichtung	Tragbarer Steuerkasten
Signalübertragung	Digital
Übertragung	Kabel

(FR)

SYSTÈME HYDRAULIQUE

Pompe	type à piston variable, à capteur de charge
Pression de système, standard	16,5 MPa
Débit	0-100 l/min

MOTEUR ÉLECTRIQUE

Puissance	30kW
Nombre de tours	Voir plaque signalétique
Tension/fréquence	Voir plaque signalétique
Courant	Voir plaque signalétique
Couple démarrage	Y/D

SYSTÈME DE COMMANDE

Dispositif de commande	boitier de commande portable
Transmission de signaux	Digital
Transmission	Câble

BROKK
SORB INDUSTRI

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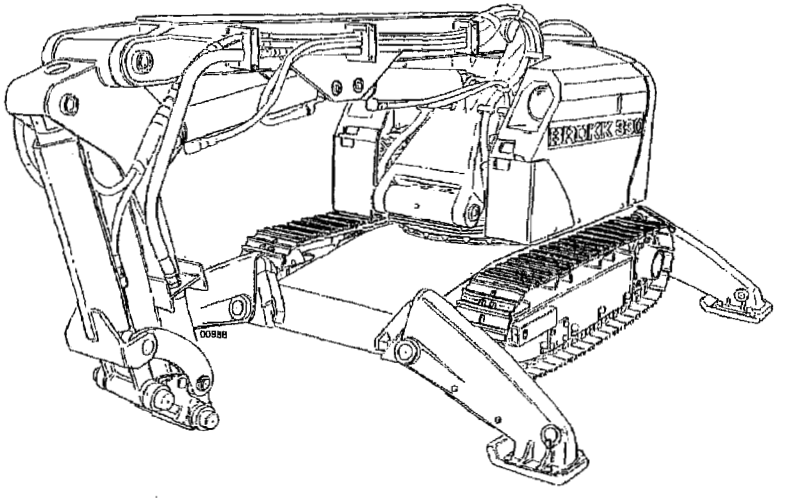
Part No. 3136 8005 04 Issue. F

BROKK
SORB INDUSTRI

(SE) # Tekniska data
(GB) # Technical data
(DE) # Technische Daten
(FR) # Caractéristiques techniques

Brokk 330



(SE)

Tekniska data

MÅTTUPPGIFTER

Transportlängd exklusive redskap	3920 mm
Transporthöjd, lägsta	1540 mm
Transportbredd, uppfällda stödben	1500 mm
Frigångshöjd, ca	200 mm
Arbetsbredd med utfällda stödben	2430 mm
Bandbredd	250 mm

VIKTUPPGIFTER

Vikt komplett utan redskap	4300 kg
Marktryck band, utan redskap	0,055 N/mm²
Vikt hammare, max	550 kg

PRESTANDA

Runtomsvängande	
Svänghastighet	14 sec/360°
Max transporthastighet	1,8 km/h
Max stigningsvinkel	30°

(GB)

Technical Data

MEASUREMENTS

Transport length excl attachment	3920 mm	154 in
Transport hight, lowest	1540 mm	60,6 in
Transport width, outriggers folded	1500 mm	58,9 in
Ground clearance, approx	200 mm	7,9 in
Operating width, outriggers folded	2430 mm	95,7 in
Track gauge	250 mm	9,8 in

WEIGHT

Weight complete excl attachment	4300 kg	9480 lb
Load tracks, excl attachment	0,055 N/mm²	
Weight, hammer, max	550 kg	1210 lb

PERFORMANCE

Unlimited revolutions		
Slewing speed	14 sec/360°	
Maximum travel speed	1,8 km/h	1,1 mi/h
Gradient	30°	

(DE)

Technische Daten

MAßE

Länge, Fahrstellung ohne Anbaugeräte	3920 mm
Höhe, Fahrstellung, Mindesthöhe	1540 mm
Breite, Fahrstellung, mit hochgeklappten Stützbeinen	1500 mm
Bodenfreiheit	200 mm
Breite, Arbeitsstellung, mit hochgeklappten Abstützungen	2430 mm
Raupenbreite	250 mm

GEWICHTE

Gewicht komplett ohne Anbaugerät	4300 kg
Bodendruck, Raupe ohne Anbaugerät	0,055 N/mm²
Gewicht hammer, maximal	550 kg

LEISTUNG

Endlos drehung	
Schwenkgeschwindigkeit	14 sec/360°
Fahrgeschwindigkeit, maximal	1,8 km/h
Maximale Steigung	30°

(FR)

Caractéristiques techniques

DIMENSIONS

Longueur, outil n.c.	3920 mm
Hauteur mini de transport	1540 mm
Largeur, béquilles relevées	1500 mm
Garde au sol	200 mm
Largeur avec béquilles déployées	2430 mm
Largeur de chenille	250 mm

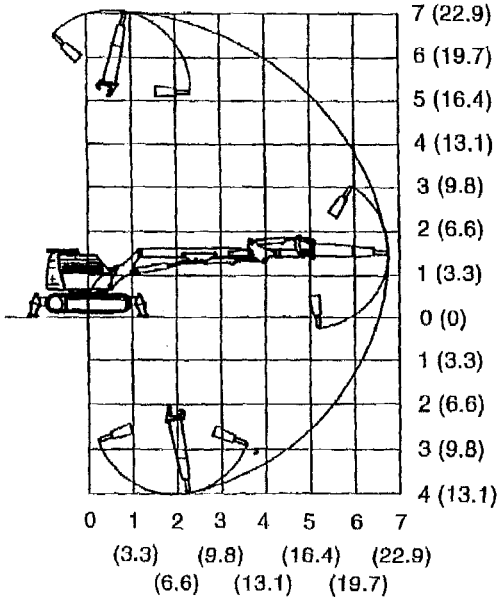
POIDS

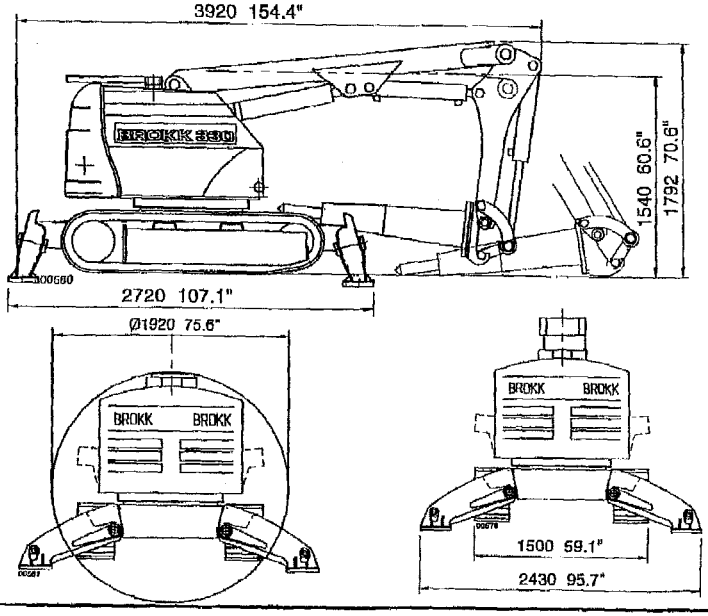
Poids total, sans outil	4300 kg
Pression au sol, chenille, sans outil	0,055 N/mm²
Poids marteau, maxi	550 kg

PERFORMANCES

Rotation illimitée	
Vitesse de rotation maxi	14 sec/360°
Vitesse maxi de transport	1,8 km/h
Pente	30°

Dimension in m (ft)

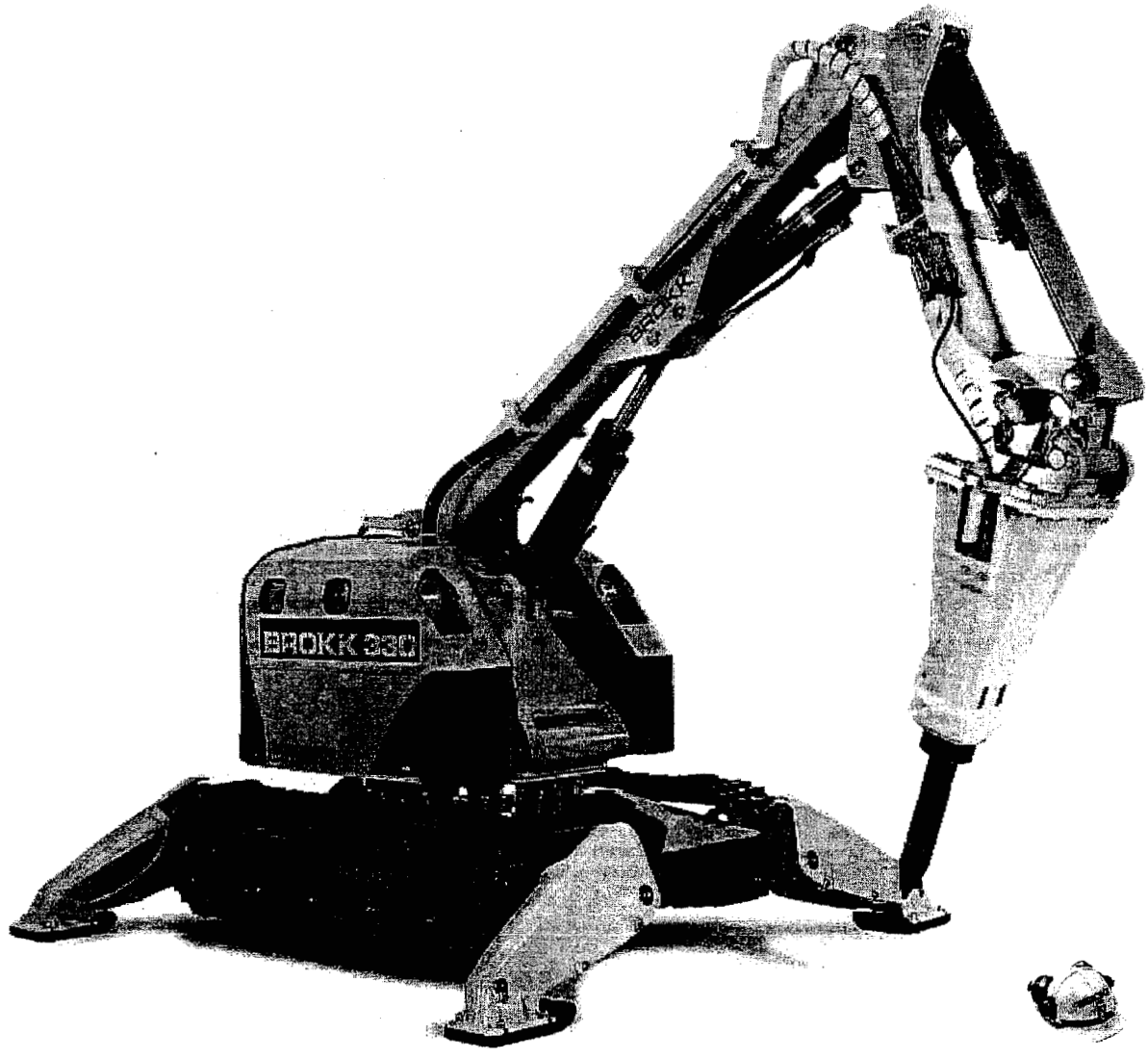




BROKK®

SORB INDUSTRY

Brokk 330



Extra demolition power *for the heaviest tasks*

Brokk 330

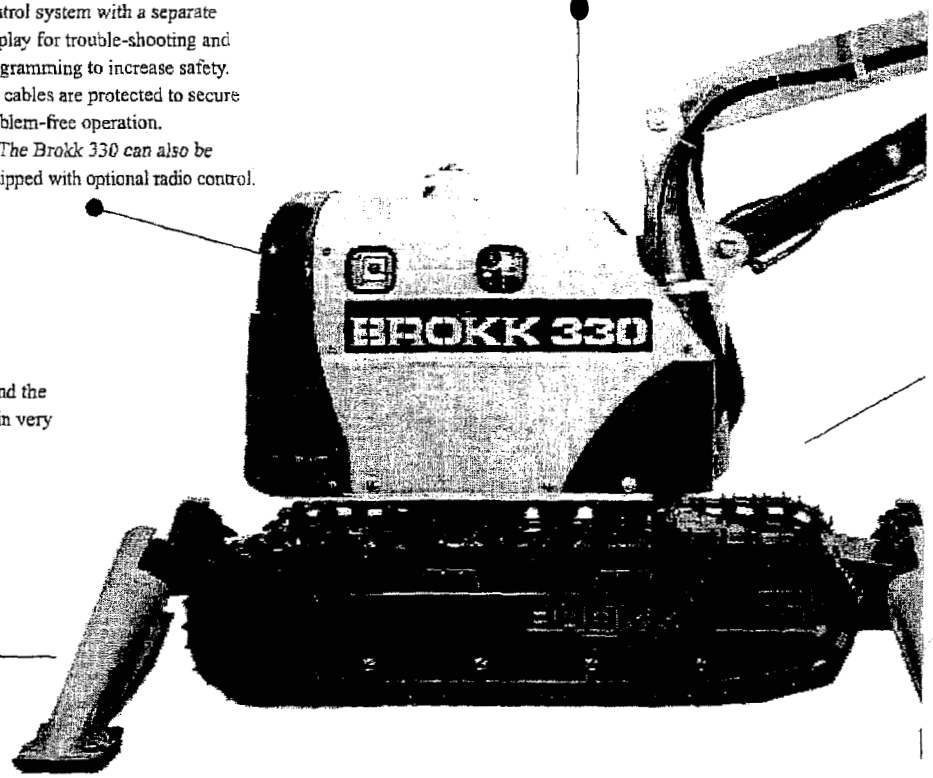
Electric motor

Thanks to the 30 kW motor, the Brokk 330 can carry very powerful tools. Subsequently it performs very heavy and difficult demolition tasks in an efficient way.

Control system

Brokk 330 has a modern, digital control system with a separate display for trouble-shooting and programming to increase safety. All cables are protected to secure problem-free operation.

The Brokk 330 can also be equipped with optional radio control.



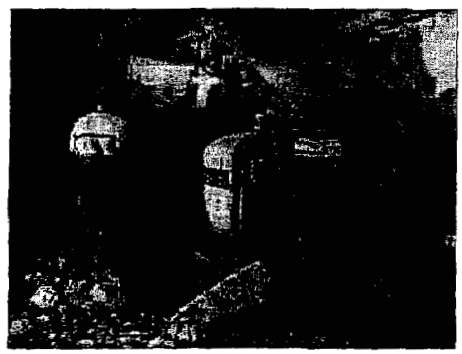
Compact design

Small exterior dimensions and the compact design make work in very tight spaces possible.

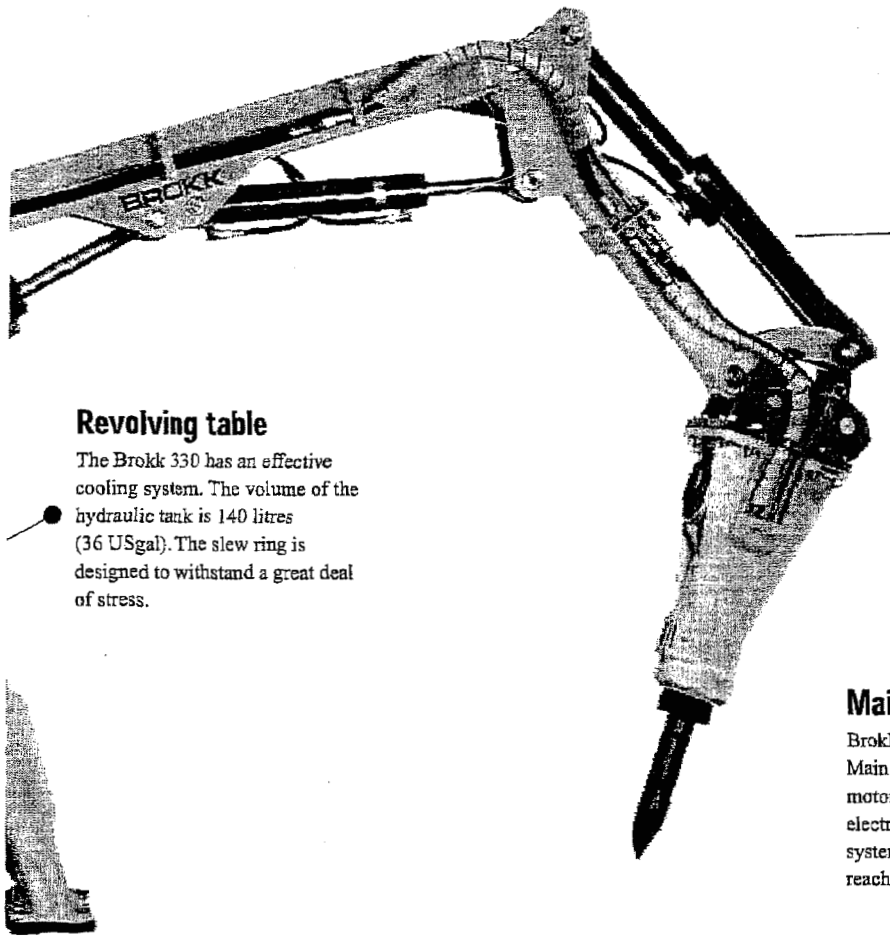
Undercarriage

Support leg cylinders, hoses and couplings are protected to avoid damage. Steel caterpillar tracks.

When the Brokk 330 is equipped with a crusher, you can use it for very heavy demolition work, even during the day in densely populated areas.



Building demolition is one area where you can use the Brokk 330 for very heavy tasks. Here, a bank vault is being demolished so that the area can be used for other purposes. The Brokk 330 demolishes quickly and efficiently, when for different reasons, the amount of demolition time is limited.



Arm system

The Brokk 330 can carry and work efficiently with tools weighing up to 550 kg (1210 lb), which is unique for this type of machine.

The machine's reach is approximately 7 metres (273 in) with a hammer and the turning radius is 360 degrees.

The machine is equipped with expansion shafts in the joints, protection for the tilt cylinder and a quick hitch for easy replacement of tools.

Revolving table

The Brokk 330 has an effective cooling system. The volume of the hydraulic tank is 140 litres (36 USgal). The slew ring is designed to withstand a great deal of stress.

Maintenance

Brokk 330 is very easy to service. Main components like filter, electric motor, hydraulic pump, valves, electric connections, cooling system and fan are within easy reach.

The strongest demolition machine

Strongest in the Brokk series

The Brokk 330 is the strongest demolition robot in the Brokk series. It is also the demolition robot that currently has the highest capacity in the world. You can equip the Brokk 330 with tools such as hydraulic hammers, concrete crushers, drilling equipment, different types of buckets, etc. with a weight of up to 550 kg (1210 lb), even though the machine only weighs 4200 kg (9240 lb). When you need extra power for maximum capacity and efficiency, the Brokk 330 is your obvious choice.

Effective at foundries ...

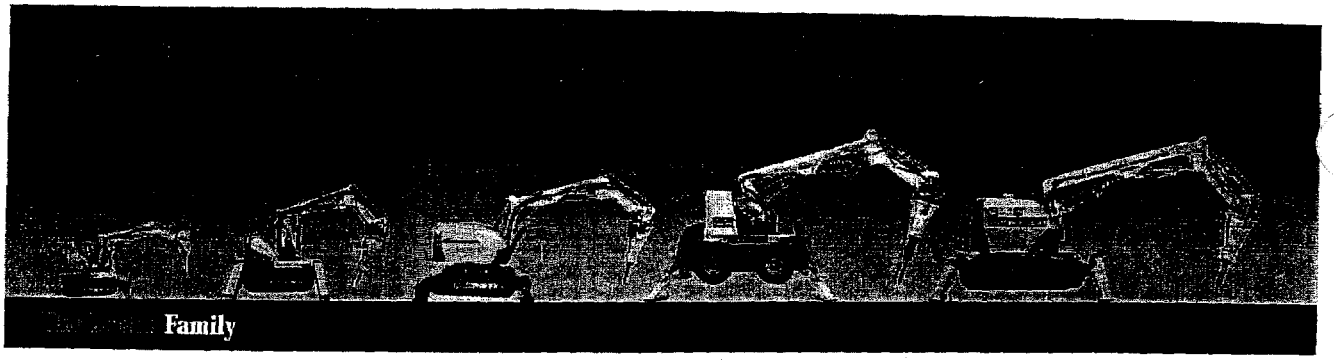
You can use the Brokk 330 for all kinds of demolition work. In the processing industry, slag lining removal and cleaning of ladles and furnaces are just a few examples of the types of work that you can do efficiently using the Brokk 330. Other usage includes replacing the linings in cement and pig iron furnaces, removing linings in tile stoves, and when demolishing within the pulp industry.

... and for heavy construction demolition

You can also use the Brokk 330 for very heavy demolition within the construction industry. Experienced operators and the Brokk 330 can do all these tough jobs faster, safer, and more efficiently.

Safety with Brokk

Brokk makes the workplace safer. Operators control the machine with the aid of a remote control, which means that they can remain at a safe distance from falling debris. The standard Brokk machine is electrically powered, which also improves the working environment compared to diesel-powered machines.



Family

Facts	Products					
	Brokk 40	Brokk 90	Brokk 90	Brokk 180	Brokk 250	Brokk 350
Weight, kg (lb)	380 (794)	830 (1830)	930 (2050)	1900 (4190)	3060 (6750)	4100 (9030)
Width min. mm (in)	600 (23,6)	780 (30,7)	780 (30,7)	800 (39,4)	1200 (47,2)	1500 (58,5)
Height min. mm (in)	740 (28,8)	1210 (47,6)	1210 (47,6)	1342 (52,8)	1760 (69,3)	1540 (60,6)
Motor output, kW	4	7,5	11	15/18,5	22	30
Recommend./max. weight attachment, kg (lb)	60 (132)	75 (165)	120 (265)	230 (507)	350 (771)	550 (1210)

Typical Brokk! *With more than 20 years of experience and as the leading manufacturer of demolition robots, we know what's needed. A world-wide sales and service organisation is your guarantee for quick, reliable service.*

Each Brokk machine is built to meet the most stringent requirements. When the situation seems hopeless, Brokk is the answer. Typical Brokk work!

You cannot afford to wait any longer.
Welcome to the Brokk family!

Pictures are illustrative only and do not necessarily show the configuration of products on the market at the given point in time. Products must be used in conformity with safe practice and applicable safety, regulations, codes and ordinances.

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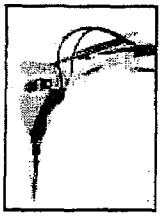
Art. nr./Part No. 3136 7035 69, Rev./Issue C

Accessories

Hydraulic breaker

The most common attachment used on a Brokk machine is a hydraulic breaker. Our main range that suits our machines includes the following breakers:

Brokk 40 – SBC60



Brokk 90 – SBC115

or – SBC255

Brokk 180 – SBC410

Brokk 250 and 330 – SBC610,

Brokk 330 also SBC800

Click on the pictures to enlarge them.

Other types of breaker can also be used on Brokk machines. The size of the chosen breaker depends a lot on the weight ratio. It may sometimes be necessary to use a side-angling device.

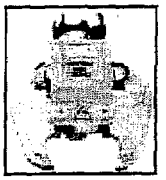
Your local Brokk dealer or our head office can help you with more information info@brokk.com

Concrete crusher

We can offer the following three models:

Brokk CC260– developed especially for the Brokk 40

Brokk CC320 – to be used with Brokk 90



Brokk CC400 – for Brokk 180

Brokk CC560 – designed for Brokk 250 and 330

Click on the pictures to enlarge them.

For technical details click on Brokk CC260 technical data, Brokk CC320 technical data, BrokkCC400 technical data or Brokk CC560 technical data. You need to have a program that can read this type of file (.pdf) e.g. Actrobat Reader. You can download it free from Acrobat Reader.

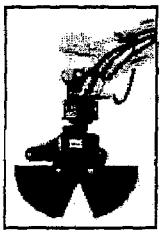
To see the crushers in action, check out range of uses

Bucket

There is at least one type of bucket available for each Brokk model, sometimes several. The buckets are used mainly to clear away debris but can also be used to turn Brokk into an ordinary digger for drainage work, etc.

Clamshell bucket

We can also offer a range of clamshell buckets.



Grapple

We can provide three sizes of grapple. They can be used e.g. for clearing away piping and ventilation ducts. The grapples are called **Brokk G30**, **Brokk G50** and **Brokk G80** (no picture available). They are designed for Brokk 40, 180 and 250/330 respectively. Click on the pictures to enlarge them.

Brokk G30

Brokk G50

Other tools

We can also offer other tools, such as drilling equipment, cutters, steel shears, etc. A range of other accessories is also available for increased safety and to maximise the use of the machines.

For more detailed information concerning our accessories, please get in touch with your local Brokk dealer or with our head office directly info@brokk.com

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The name

The name has been taken from the mythical figure Brokk, who forged the god of war Thor's sword in the realm of the Norse gods. Brokk was *small but very strong*, just like our machines.

He was also something of an artful character, which could also characterise our designers, or perhaps the people who use the machines?

Characteristics

Distinguishing features for Brokk are:

Remote control - operated from a portable cable or wireless control box.
Electric-hydraulic operation – no exhaust fumes, low noise levels.
Compact power – small dimensions, lightweight but strong.
Wide range of options – can be equipped with many different types of attachment.

BROKK®

- can carry very powerful atttachments for its weight

Range of uses

Construction

(Click to enlarge the pictures)

Demolishing buildings includes a number of tasks for which you can use your Brokk machine. The first thing that comes to mind is probably the demolition of concrete structures using a hydraulic breaker.

In some cases, concrete can also be crushed using a concrete crusher. This method is faster and quieter. Adjoining work can often continue uninterrupted and demolition can even take place at night.

Brokk machines are mostly used for partial demolition during the renovation of buildings. This is also when its compact size and flexibility comes to its right. Its precise control enables demolition of only the sections that need to be removed, while leaving the remaining sections unscathed. Electric operation also makes it easy to use indoors.

Brokk is also employed for chiselling up channels in floors to allow the replacement of drains, removing tiles and clinker, completely or partially demolishing walls and pillars, cutting down pipes, demolishing chimney stacks from top to bottom, etc. There is a Brokk model for all jobs.

From a work environment point of view, Brokk is excellent; no exhaust fumes, no vibration injuries, good operator visibility, small risk of injury due to falling objects. This is the reason for Brokk becoming a household word in the construction industry.

Renovating buildings is most common in large urban areas. The innumerable concrete blocks that were built after the war are now of an age that requires substantial renovation. Here, an efficient worker such as Brokk is an invaluable asset.

Another benefit in using a Brokk machine is that it facilitates recycling of the material resulting from the demolition. You don't just blast it all away, it must be disassembled into its component parts and sorted.

Retaining old facades while renovating the inside of buildings is also commonly done. Selective demolition is then a necessity, i.e. you must choose what to remove and demolish only that.

Learn more about construction demolition from the Demolition Handbook.
You need a special program to read this type of file (.pdf). You can download it here Acrobat Reader

Process

Click on the pictures below to get a better view of what Brokk can do within the processing industries.

Processing industries where Brokk machines have been put to use are steelworks, aluminium, copper and other metal production processes, foundries, paper mills, etc.

These industries offer ideal opportunities for Brokk machines to prove their versatility and adaptability.

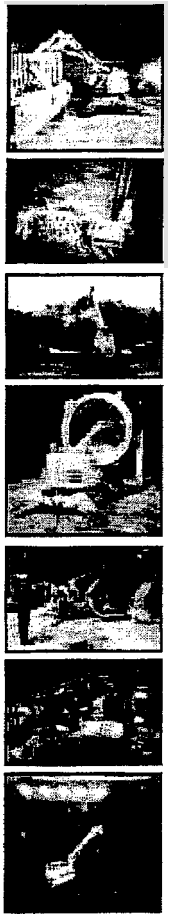
Among the most common areas of use is stripping linings in ladles, kilns, torpedo cars, tapping spouts, runners, etc.

Removing linings is a very delicate task. It is important not to damage the bottom lining which is costly to repair or replace. Brokk robots can be operated with great accuracy. The remote control makes it possible for the operator to stand close to the working area of the breaker.

As every minute of downtime in the process industry is extremely expensive, maintenance work must be carried out quickly. This is where Brokk is at its best as the machine can get to work immediately even though heat, gas and dust may prevent people from entering the place.

Quite a bit of other demolition work must also be done on industrial sites, such as clearing slag and demolishing foundations.

In their standard configuration, Brokk machines can cope with most environments. In extremely demanding and aggressive environments, they can be equipped with extra options such as heat protection.



See the special brochure for Brokk in process.
You need a special program to read this type of file (.pdf). You can download it here Acrobat Reader

Cement

Cement industries worldwide use Brokk for stripping linings and cleaning kilns. Brokk does this so well that cleaning just one kiln is usually enough to earn back the initial investment. The machine can get to work much earlier, even before the kiln has completely cooled down. Brokk is electrically powered and can therefore operate inside the kiln without causing exhaust problems.

Earlier methods of blasting away the surface were very difficult to control. When a Brokk robot is used, the operator can stand away from the falling debris and the machine is so easy to operate and works with such precision that the underlying surfaces are left undamaged.

Brokk can be used both for complete and for partial renovation of cement kilns. Its compact size enables it to pass through narrow kiln openings. Each hour of production standstill costs a lot of money at a cement plant, making short kiln downtime a necessity. Putting a Brokk machine with skilled operator to work saves time which translates into increased productivity and output.

And when new refractory bricking is to be put in place, you can use equipment supplied by our U.S. subsidiary, Brokk Bricking Solutions. They provide equipment such as a mechanised installation rig, laser instrumentation and transport system for the brick. You can learn about their method and products in the article "Reducing downtime" and "Reducing refractory costs". For additional details, please visit www.brickingsolutions.com.

See the special brochure for Brokk in cement. You need a special program to read this type of file (.pdf). You can download it here Acrobat Reader

Nuclear

If ever there is a reason to use remote controlled machines, it is when it comes to handling nuclear waste. Brokk manipulators therefore have a place to fill in the civil and military nuclear industries around the world.

Although the machines must often be provided with special equipment and features to work in nuclear industries, they are still based on the well-proven Brokk technology. Remote control, electrical operation, compact size, precision and strength - all the outstanding features of a Brokk machine are required here.

Brokk remote controlled manipulators can be used as a transportable or stationary robot in contaminated areas.

Other applications

Brokk can also be used for other applications. There are stationary units working with crushing machines, robots working in sugar plants, renovating bridges, clearing asbestos, renovating tunnels, cleaning sewer tunnels with remote control - the list of applications where Brokk machines make a difference can be made very long.

EDF Title: **TSF-26 RUBB BUILDING SYSTEMS SPECIFICATIONS AND VENDOR QUOTES**

Project No.: 2000-096	Project Title: OU 1-10, TSF-26 REMEDIATION

Project Specific Activity: TEMPORARY ENCLOSURE STRUCTURE SPECIFICATIONS / QUOTES

Problem Statement:

Develop a "Temporary Enclosure Structure" from currently fabricated and commercially available building system manufacturers to meet the associated needs of the PM-2A Tanks (V-13 [East Tank] and V-14 [West Tank]) Remedial Action Operations. The Temporary Enclosure Structure would provide a "Secondary Confinement" of any airborne waste generated during waste removal operations. Includes the following critical items:

- Minimize Weight due to Crane Lifting Capacity and Site Restrictions
- Optimize Size to assure BROKK work efficiencies within the Enclosure
  - RUBB THA Shelter [26.2' width x 65.0' length]
  - RUBB Special Enclosure [16'0" width x 35'0" length] has 22'0" Side Walls to provide cover over the Waste Vacuum System - Cyclone Separator Hopper
- Minimize Cost / Manufacturing Lead & Deliver Time

Summary of Conclusions:

TSF-26 Site:

- RUBB THA - Cost ==> $22,000
- RUBB THA - Weight ==> 7,175 lbs
- RUBB Special Enclosure - Cost ==> $31,000
- RUBB Special Enclosure - Weight ==> 4,730 lbs

The GROVE TGMK5240 has sufficient lifting capacity to complete the designated lifts at the required offset distances from the excavation and not exceed 80% of design capacity. This would then not require a "Lift Plan" and be considered a "Normal Lift Operation".

REVIEW AND APPROVAL SIGNATURES:

	R/A	TYPED NAME/ORGANIZATION	SIGNATURE	DATE
PREPARED BY:		D. J. Kenoyer		24 Oct 03
CHECKED BY:		KEVIN SHABER		10/20/03
INDEPENDENT REVIEWER		ORB		
APPROVAL:			GARY MECHAM	10/21/03

Distribution:

Registered Professional Engineer's Stamp (if required)

PROBLEM STATEMENT:

TSF-26 Site Remediation Operations require the removal of the waste PM2A Tanks [V-13 (East Tank) and V-14 (West Tank)] and the placement of temporary enclosure structures [RUBB THA Shelter / RUBB Special Shelter]. The weight of these items was calculated and the GROVE GMK5240 Technical Manual consulted to assure these items could be handled during the Remedial Action Operations.

The Temporary Enclosure Structures must be durable [ability to last the life of the project without repair and/or maintenance - 12 months], lightweight, and cost effective. INTREPID will prepare a "Specification" for the "Temporary Enclosure Structures" based upon information developed in this research.

The placement / positioning of the GROVE GMK52400 crane is critical in relationship to the edge of the excavation to assure there is no failure of soil stability in that area.

ASSUMPTIONS:

The Assumptions utilized in the performance of these specifications / calculations are outlined below:

- General Specification for RUBB THA Shelter and RUBB Special Shelter
  - Steel Structural Framing System for strength [truss or tube framing system]
  - Translucent Panels for Roof to allow light filtration into facility [minimize need for lighting]
  - Continuous Steel Framing at bottom for lifting and anchoring [utilize Jersey Bouncer (concrete traffic barriers) for structure ballast]
  - Internal Lifting Framing System [allow structure to be lifted by crane]
  - Personnel and Equipment Access Doors [allow placement of BROKK 330 into facility]
  - On-Site Assembly and Erection of Structure
- Lifting capabilities of GROVE GMK5240 based upon Guide Chart
- Weight calculations of RUBB THA Shelter based upon General Specification, Subsection 1.1
- Weight calculation of RUBB Special Enclosure based upon technical representative phone conversation

REFERENCES:

GROVE TM9120 Lifting / Crane Capabilities Guide Chart, page 7
RUBB THA Shelter General Specification, dated 24-Apr-03
RUBB General Technical Specifications for RUBB Buildings and Shelters (GTS) 4/01
RUBB THA Shelter Vendor Quote, dated 15-Jul-03
Phone conversation with RUBB Technical Representative, Mark Boutet, on 16-Jul-03 @1247 MST ... standard 3." X 3.5" angle is ¼" thick.
Phone conversation with RUBB Technical Representative, Xxxx Yyyy, on 17-Oct-03 @1450 MST ... the RUBB Special Enclosure weight works out to be 8 pounds per square foot.

CALCULATIONS / ANALYSIS:

See Attached RUBB Manufacturers Technical Specifications for the THA Shelter

- RUBB THA Shelter [26.2' width x 65.0' length]
  - Cost ==> $22,000
  - Weight ==> 7,175 lbs
  - Galvanized Steel Structure
  - Continuous 3.5" x 3.5" galvanized base angle foundation
  - PVC Folding Door [Equipment Access] in one gable
  - Vents at gables at both ends
  - PVC coated polyester fabric roof (white translucent) and walls (colored) [flame retardart]

CALCULATIONS / ANALYSIS -(CONTINUED):

See Attached RUBB Manufacturers Technical Specifications for the Special Enclosure

- RUBB Special Shelter [16.0' width x 35.0' length] with 22'0" High side walls
  - Cost ==> $31,000
  - Weight ==> 4,730 lbs
  - Galvanized Steel Structure
  - Continuous 3.5" x 3.5" galvanized base angle foundation
  - Overhead Rollup Door [Equipment Access] in one gable
  - Vents at gables at both ends
  - PVC coated polyester fabric roof (white translucent) and walls (colored) [flame retardart]

INTREPID must come up with a "Hold-down Structural Member" to attach to the 3.5" x 3.5" galvanized base angle foundations to allow the Jersey Bouncers to be placed on to act as ballast. The 3.5" x 3.5" galvanized base angle foundations are ¼" thick per conversation with RUBB technical representative. It is recommended that a standard ¼" thick, 3 ½" wide, and 2'0" long bar stock be utilized to weld to the bottom of this foundation angle at the locations where the steel trusses tie into the foundation angle [apply a ¼"-weld 2" long on each weld face]. This will provide the necessary hold-down support with the Jersey Bouncers acting as ballast.

These temporary enclosure structures are to be located at the bottom of the excavation for the PM2A Tanks which is approximately 16'0" deep. Since the RUBB THA Shelter is only 3 meters (approximately 11'0") at the side walls and only 5 meters (approximately 16'6") at the gable ends, most of the structure will be out of the direct wind and should not encounter significant wind forces (over turning, push, lift). The RUBB Special Shelter has side walls approximately 7 meters high (approximately 22'0") and may represent a higher wind profile than the adjacent RUBB THA Shelter.

The following is a listing of the attached RUBB information [22 pages]:
- RUBB Telefax Vendor Quote, 17-Oct-03, 3 pages
- RUBB Telefax Vendor Quote, 15-Jul-03, 3 pages
- RUBB Letter THS Shelter Photos, 15-May-03, 3 pages
- RUBB Letter Vendor Quote, 24-Apr-03, 2 pages
- RUBB THA Shelter General Specification, 4 pages
- RUBB Business Card, 1 page
- RUBB Letter Vendor Quote, 22-Apr-03, 2 pages
- RUBB Detailed Engineering Drawing for THA Structure 40' span, 1 page
- RUBB General Technical Specifications for RUBB Buildings and Shelters (GTS) 4/01, 6 pages

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RUBB BUILDING SYSTEMS

TELEFAX

COMPANY:	Intrepid Engineering Services, Inc.
ATTN:	Mr. Doug Larson
FROM:	Bob Normandeau (bnormandeau@rubbusa.com)
FAX NO:	208-529-1014
NO. SHEETS:	3
REF:	Budgetary Quote
DATE:	October 17, 2003

RUBB INC.,
Sanford Airport
P.O. Box 711
Sanford, Maine 04073
Tel: (207) 324-2877
Fax: (207) 324-2347
E-mail: info@rubbusa.com

Sent [ ]

Doug,

Attached you will find a copy of the budgetary quote that you requested.After your review if you have any questions please call me at your convenience. The quote as usual is set up in a line item format. The last quote didn't require site erection and other items .You can deduct these if you don't need them.

Thanks,

Bob

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RUBB, INC.
P.O. Box 711, 1 Rubb Lane
Sanford, Maine 04073 USA
Tel: 207 324 2877
Fax: 207 324 2347
E-mail: info@rubbusa.com

October 17,2003

Intrepid Engineering Services, Inc.
Mr. Doug Larson
501 West Broadway Street
Idaho Falls, ID 83402

0481-03BJN

Dear Mr. Larson,

It was a pleasure speaking with you over the phone. Following is the budgetary quote that you requested during our last phone conversation. After your review if you have any questions please call me at your convenience.

16' x 35'(W x L) BVR Rubb building, with 22' sidewalls:	$ 19,363

This budgetary price includes a complete steel structure. The steel is hot dip galvanized after the welding process to provide a maintenance free structure. As standard, the Rubb building is supplied with vents in the gables. The walls and roof are clad with a 28 oz./sy PVC coated polyester fabric. The roof is translucent white and the walls are available in a range of standard colors. The material is flame retardant. The building will be supplied according to BOCA building code based on a ground snowload of 25 psf, a basic steady wind speed of 90 mph and a 3 psf collateral load. Structural calculations are available to assist with application for building permission if required. Material test certificate can be provided. Unless otherwise specified, foundation is customer's responsibility.

(1) 3' x7' (w x h) steel personnel access door: (Including support wood/steel framing)	$ 800
(1)14 x 16' (w x h) overhead industrial rolling steel door:	$ 4,724
(1) Set of resin bolts to attach building to existing concrete pad:	$ 612
(1) Set of lifting bracket and cable assemblies:	$ 1,000
Freight Charge:	$ 4,500
Estimated Installation: (Non-Union Rubb Crew, Standard Wages, Travel, Equipment, Expenses)	$ 9,800

40,800
<9,800>
31,000

October 17, 2003
Mr. Doug Larson
Page 2 of 2

Total: **$ 40,799**
31,000

All prices are based on U.S. Dollars, FOB Sanford, Maine, and are good for 60 days. Our prices exclude sales tax, building permissions or fee's and any bonding requirements. Also excluded are any utility connections to facility for required water, electrical, telephone and fire alarm services. All sales are subject to Rubb, Inc.'s General Terms and Conditions.

Our standard terms of payment for a purchase are: 40% due with order, 50% upon delivery and 10% due net 30 days with a 1% discount if paid within 10 days.

I hope that you find the enclosed of interest and that we have the opportunity to discuss your requirements in the near future. If you feel that a meeting would be beneficial, or if any additional information is required, please contact me at 1-800-289-7822 and I would be happy to assist you further.

Assuring you of our best attention to quality and service at all times.

Sincerely
Rubb, Inc.

Robert Normandeau

Bob Normandeau
Bulk Facility Sales

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RUBB BUILDING SYSTEMS

TELEFAX

COMPANY:	Intrepid Engineering Service Inc.
ATTN:	Doug Larson
FROM:	Bob Normandeau (bnormandeau@rubbusa.com)
FAX NO:	208-529-1014
NO. SHEETS:	3
REF:	Budgetary Quote
DATE:	July 15, 2003

RUBB INC.,
Sanford Airport
P.O. Box 711
Sanford, Maine 04073
Tel. (207) 324-2677
Fax: (207) 324-2347
E-mail: info@rubbusa.com

Sent: [ ]

Doug,

Attached you will find the revised budgetary quote we discussed earlier on the phone. If you have any questions please call.

Thanks,
Bob

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RUBB, INC.
P.O. Box 711, 1 Rubb Lane
Sanford, Maine 04073 USA
Tel: 207 324 2877
Fax: 207 324 2347
E-mail: info@rubbusa.com

July 15, 2003

Intrepid Engineering Services, Inc.
Mr. Doug Larson
501 West Broadway Street
Idaho Falls, ID 83402

0234-03aBJN

Dear Doug,

Thanks for your continued interest in Rubb Buildings. Per our conversation, please find pricing on a new 10m x 65' THA shelter that you requested.

(1)) 26.2' x 65' Tha Range Rubb shelter with an 11' sidewall	$ 17,300

This price includes a complete galvanized steel structure manufactured and ready for erection by using sleeve joints and a PVC folding door in one gable. As standard, the Rubb shelter is supplied with vents in the gables. The walls are covered with colored and the roof with white translucent high strength, PVC coated polyester fabric. The material is flame retardant. Secure fastening to the ground and erection is customer's responsibility.

(1) Set of lifting eyes and cables:	$ 800
(1) Set of foundation ballasts:	$ 500
(1) Freight Charge:	$ 3,400
Total:	**$ 22,000**

The THA shelter comes standard with a continuous 3.5" x 3.5" galvanized base angle foundation. This can be affixed to either prepared or natural ground surfaces with a variety of fastening methods.

The THA shelter has been created to serve as a heavy duty, all purpose shelter. Though not designed to the strict code standard of our building ranges, the THA shelters have been destruction tested at our factory to ensure their reliability in the field. The THA's primary advantages are as follows:

1. Low initial and lifetime costs
2. Can be erected or dismantled with minimal tools

3. Can be erected on almost any surface
4. Packs to a small shipping volume
5. High degree of part interchangeability

For many storage and site workshop situations, the THA provides the optimal solution to the need for durable cover and planning flexibility.

All prices are based on U.S. Dollars, FOB Sanford, Maine, and are good for 60 days. Our prices exclude sales tax, building permissions or fee's and any bonding requirements. Also excluded are any utility connections to facility for required water, electrical, telephone and fire alarm services. All sales are subject to Rubb, Inc.'s General Terms and Conditions.

Our standard terms of payment for a purchase are: 40% due with order, 50% upon delivery and 10% due net 30 days with a 1% discount if paid within 10 days.

I hope that the enclosed information will be of help to you when you receive inquiries from municipal offices around the state If you need more information or further assistance or additional literature, please contact me at 1-800-289-7822.

Assuring you of our best attention to quality and service at all times.

Sincerely
Rubb, Inc.
Robert J. Normandeau
Bob Normandeau
Bulk Facility Sales

BN/jmb

16 July 03 @ 1247 MST DJKenyon
1-800-289-7822 Mark Boutet
3.5 x 3.5 ~ 1/4 ? Angle Iron ✓

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RUBB, INC.
P.O. Box 711, 1 Rubb Lane
Sanford, Maine 04073 USA
Tel: 207 324 2877
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E-mail: info@rubbusa.com

May 15, 2003

Mr. Doug Larsen
Intrepid Technologies
501 West Broadway Street
Idaho Falls, ID 83402

Dear Mr. Larsen,

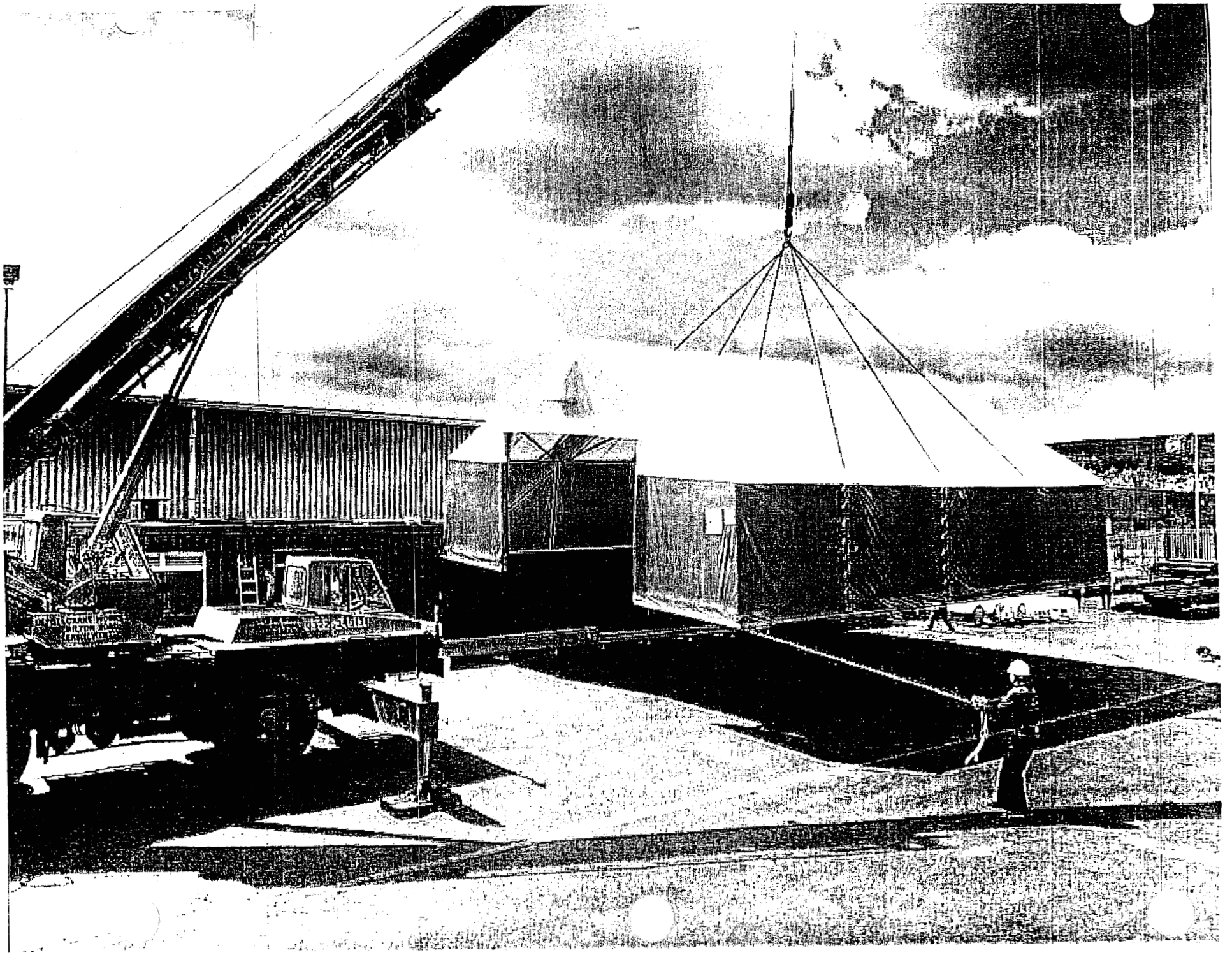
Thank you for your continued interest in our products. I have enclosed some pictures of our liftable THA shelters which I hope will be relevant to your present needs.

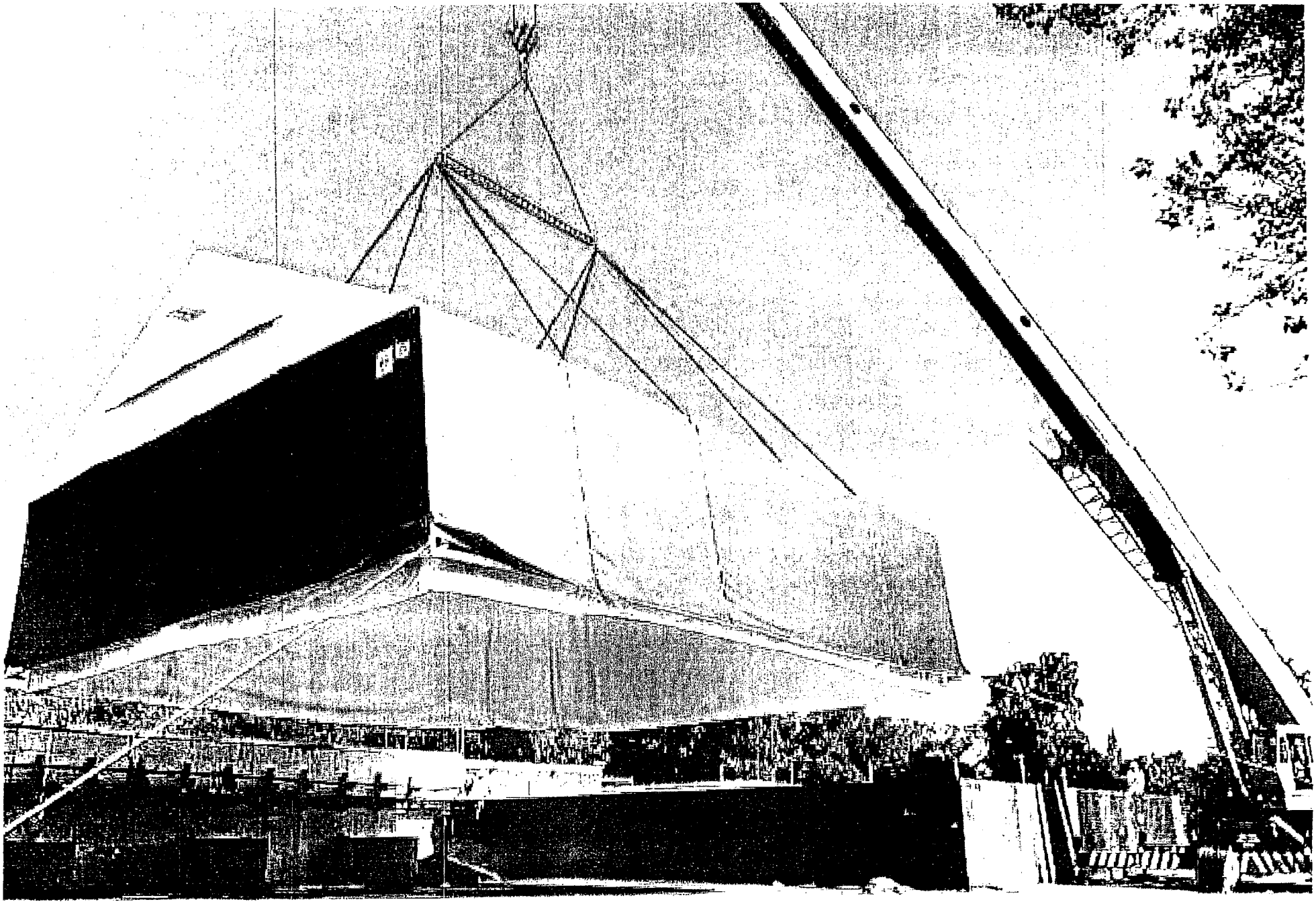
If there is any other way I can be of help. You can reach me at (800) 289-7822

Assuring you of our best attention to quality and service at all times.

Sincerely
Rubb, Inc.

Bob Normandeau
Bulk Facility Sales





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E-mail: info@rubbusa.com

April 24, 2003

Mr. Doug Larsen
Intrepid Engineering Services, Inc.
501 West Broadway Street
Idaho Falls, ID 83402

0234-03 JWD

Dear Doug,

Thanks for your continued interest in Rubb Buildings. Per our conversation, please find enclosed pricing on a new THA Range Shelter that you requested.

(1) 40' x 70' THA Range Rubb Shelter with an 11' sidewall:	$21,000

This price includes a complete galvanized steel structure manufactured and ready for erection by using sleeve joints and a PVC folding door in one gable. As standard, the Rubb shelter is supplied with vents in the gables. The walls are covered with colored and the roof with white translucent high strength, PVC coated polyester fabric. The material is flame retardant. Secure fastening to the ground and erection is customer's responsibility.

(1) Set of Lifting Eyes and Cables:	$ 800
(1) Foundation Ballast:	$ 500
Estimated Shipping Cost:	$ 3,400
Total Price:	$25,700

The THA shelter comes standard with a continuous 3.5" x 3.5" galvanized base angle foundation. This can be affixed to either prepared or natural ground surfaces with a variety of fastening methods.

Cost to provide a Rubb factory trained technician to assist your crew is $500 per day. Cost includes room and board, and assumes up to a ten hour day. Cost does not include transportation. Airfare and car rental are billed at cost plus 10% or mileage is billed at $0.36 per mile. Travel days and downtime requiring our personnel to be at your location but not working are billed at $250 per day.

All prices are based on U.S. Dollars, FOB Sanford, Maine, and are good for 60 days. Our prices do not include freight cost, sales tax, technical services, building permissions, foundation or erection unless otherwise specified. All sales are subject to Rubb, Inc.'s General Terms and Conditions.

Our standard terms of payment for a purchase are: 40% due with order, 50% upon delivery and 10% due net 30 days with a 1% discount if paid within 10 days.

I hope the above meets with your approval and look forward to hearing from you. If any further information is required, please don't hesitate to give me a call at your convenience.

Assuring you of our best attention to quality and service at all times.

Best Regards
Rubb, Inc.

Robert J Normandeau

Bob Normandeau
Bulk Facility Sales

THA SHELTER GENERAL SPECIFICATION

- 1.0 Description - General

  The THA shelter consists of a series of galvanized steel sections which pin together to form the structural framework, over this framework is tensioned a high strength PVC coated polyester fabric. The shelter comes standard with a continuous galvanized base angle to provide a complete weather seal. The structure is rectangular in shape with vertical gable walls and sidewalls inclined at a 5 ° slope. This shape offers maximum usable space per covered square foot.

- 1.1 Weight (lbs)

  The THA has a finished weight according to the following table:

	19.7' Span	26.2' Span	32.8' Span	39.4' Span
20' length	2420	3630	4140	4990
30' length	3040	4340	5095	6140
40' length	3660	5050	6050	7290
each add'l 10' module	620	710	955	1150

- 1.2 Dimension (ft)

  The structure sidewall heights, exterior peak heights and interior peak heights are given below:

	19.7' Span	26.2' Span	32.8' Span	39.4' Span
Length (outside)	(Stated length + 3" i.e. 80' = 80'3")			
Width (outside)	(Stated width + 2" i.e. 19.7' = 19.9')			
Sidewall height	11.0'	11.0'	11.0'	11.0'
Exterior peak height	15.7'	17.5'	19.2'	21.0'
Interior peak height	14.9'	14.2'	15.9'	17.7'

- 1.3 Material

- 1.3.1 Steel

The steelwork is composed primarily of 3" and 3-1/2" diameter round steel tubing. Most tubing is purchased to ASTM A500B specification with a minimum yield strength of not less than 50,000 pounds. The steelwork is either pre-galvanized or hot dip galvanized after fabrication to provide corrosion protection.

Primary Member Sizes Table

	Diameter	Thickness	Min. Yield	Coating
Leg, Roof and Gable Tubes	3.0"	.120"	50,000 lbs.	Pre-galvanized or Hot dip galvanized
Joint Tubes (elbows)	3.5"	.180"	42,000 lbs.	Hot dip galvanized
Axial Tubes	2-3/8"	.120"	50,000 lbs.	Pre-galvanized
Mid-span Bracing	1.9"	.109"	42,000 lbs	Pre-galvanized
Secondary Span Bracing	1.25"	.095	50,000 lbs	Hot dip galvanized
Plate and Angle Fabrications	-	-	36,000 lbs	Hot dip galvanized
Fastening Clevis Pins	5/8"	-	-	Zinc plated

- 1.3.2 Fabric

The fabric is a 21 oz. PVC coated polyester. The fabric has a thickness of 28 mils, a tensile strength of 285 pounds/inch, and a tear resistant strength of 154 pounds. The fabric is treated with chemicals to resist degradation by ultraviolet light and also to be flame retardant and is self-extinguishing in accordance with NFPA701 and applicable Federal Standard. The roof is usually a white translucent and the walls are of various opaque colors.

- 1.3.3 Hardware

The primary structural members pin together using a combination of clevis pins and spring loaded pins at apex location. These pins are high strength and plated to resist corrosion.

- 1.4 Structural Capability

  The THA shelter has been destruction tested and proven to withstand live loadings given in the table below. If loads provided here are insufficient, Rubb can provide modified designs to achieve required load capabilities. Rubb has designed structures to ground snowloads of over 50 psf and windloads in excess of 120 mph.

THA Load Capability

	19.7' Span	26.2' Span	32.8' Span	39.4' Span
Load capacity	22	19	9	11

The THA shelters have been tested applying a uniform loading to a single truss. The values shown represent tests resulting in lb/sq. ft. with a safety factor of 25%. Higher loadings can be achieved with modified truss bracing or reduced spacing between trusses.

- 1.5 Anchoring

  Several anchoring methods are available. One common method is to use galvanized steel anchor bars driven at opposing angles as shown in figure 6 of the accompanying THA shelter brochure. Another is to use anchor bolts into concrete. Alternative methods are available.

- 1.6 Doors and Ventilation

  The structure comes standard with a lace-up door in one gable. Each gable is equipped with a ventilation duct. Exhaust fans or alternative door systems can be added if desired.

- 2.0 Manufacturer

  The manufacturer shall be Rubb Inc. of Sanford, Maine USA. Rubb can provide a supervisor crew to assist in the installation of the structure. The structure shall include all necessary accessories, fasteners, anchors, and special tools as required by Rubb for erection. Estimated erection time for the structure is 40 square feet per person hour.

  Rubb buildings are warranted against all defects in material and workmanship for a period of one year from date of delivery. Rubb further guarantees that the fabric membrane will be free from any deterioration in usefulness for a period of five years. If any such defects should occur, Rubb will repair these defects at no charge to the

purchaser. Rubb will not be liable for defects which result from unforeseen acts of God; acts of war; or the negligence of the purchaser, his agents or a third party.

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RUBB
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P.O. Box 711, 1 Rubb Lane
Sanford, Maine 04073 USA
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Fax: 207 324 2347
Toll Free : 800 289 7822
E-mail: bnormandeau@rubbusa.com

Bob Normandeau

AN INTERNATIONAL COMPANY

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P.O. Box 711, 1 Rubb Lane
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Fax: 207 324 2347
E-mail: info@rubbusa.com

April 22, 2003

0228-03 JWD

Mr. Doug Larsen
Intrepid Engineering Services, Inc.
501 West Broadway Street
Idaho Falls, ID 83402

Dear Doug,

It was a pleasure speaking to you on the phone yesterday. Please find enclosed budgetary pricing information for the shelter we spoke about to cover your underground storage tank.

(1) Used 39.4' x 70' THA Range Rubb Shelter with an 11' sidewall:	$15,555

This price includes a complete galvanized steel structure manufactured and ready for erection by using sleeve joints and a PVC folding door in one gable. As standard, the Rubb shelter is supplied with vents in the gables. The walls are covered with colored and the roof with white translucent high strength, PVC coated polyester fabric. The material is flame retardant. Secure fastening to the ground and erection is customer's responsibility.

(2) 12' x 12' Framed Openings:	included
(1) Set of Lifting Eyes and Cables:	$ 800
(1) Foundation Ballast:	$ 500
Estimated Shipping Cost:	$ 3,400
Total Cost:	$20,255

The THA shelter comes standard with a continuous 3.5" x 3.5" galvanized base angle foundation. This can be affixed to either prepared or natural ground surfaces with a variety of fastening methods.

Cost to provide a Rubb factory trained technician to assist your crew is $500 per day. Cost includes room and board, and assumes up to a ten hour day. Cost does not include transportation. Airfare and car rental are billed at cost plus 10% or mileage is billed at $0.36 per mile. Travel days and downtime requiring our personnel to be at your location but not working are billed at $250 per day.

All prices are based on U.S. Dollars, FOB Sanford, Maine, and are good for 60 days. Our prices do not include freight cost, sales tax, technical services, building permissions, foundation or erection unless otherwise specified. All sales are subject to Rubb, Inc.'s General Terms and Conditions.

Our standard terms of payment for a purchase are: 40% due with order, 50% upon delivery and 10% due net 30 days with a 1% discount if paid within 10 days.

The THA shelter has been created to serve as a heavy duty, all purpose shelter. Though not designed to the strict code standard of our building ranges, the THA shelters have been destruction tested at our factory to ensure their reliability in the field. The THA's primary advantages are as follows:

1. Low initial and lifetime costs
2. Can be erected or dismantled with minimal tools
3. Can be erected on almost any surface
4. Packs to a small shipping volume
5. High degree of part interchangeability

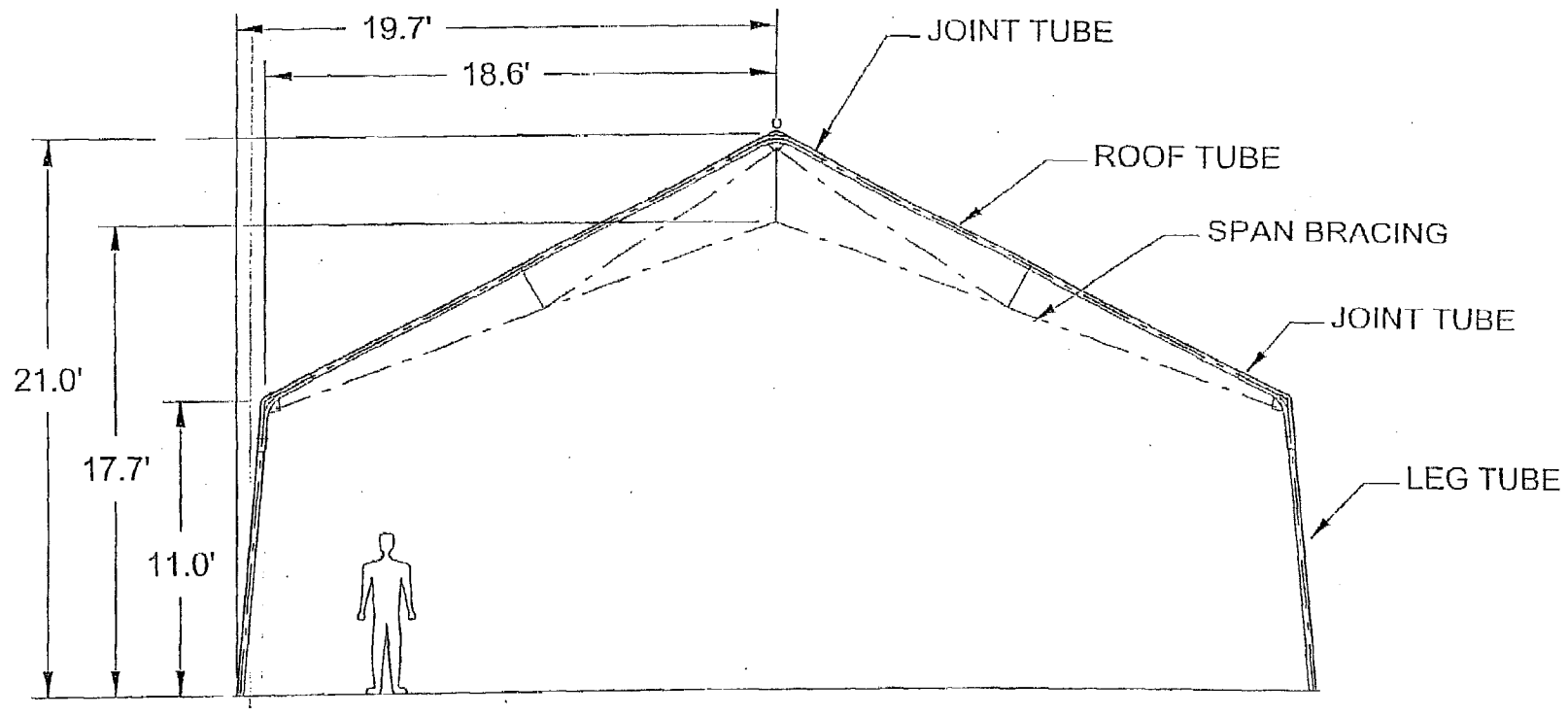
For many storage and site workshop situations, the THA provides the optimal solution to the need for durable cover and planning flexibility.

I hope the above meets with your approval and look forward to hearing from you. If any further information is required, please don't hesitate to give me a call at your convenience.

Assuring you of our best attention to quality and service at all times.

Sincerely,
Rubb, Inc.

Robert Normandeau
Bob Normandeau
Bulk Facility Sales



TITLE					
39.4' SPAN THA w/11' LEG SPAN PROFILE				We Cover The World LJRUBB BUILDING SYSTEMS	
GA	SP	SCALE	DRAWN	DATE	DRAWING NO
620 SF	65 LF	1:75	DCN	12/16/96	80038

We Cover The World

RUBB BUILDING SYSTEMS

GENERAL TECHNICAL SPECIFICATIONS FOR RUBB BUILDINGS AND SHELTERS (GTS) 4/01

1.0 RUBB BUILDINGS LTD

Rubb Buildings Ltd has for over 30 years manufactured versatile, relocatable buildings for all types of applications throughout the world. Our buildings withstand climatic conditions ranging from the tropics to the Arctic. From the outset Rubb Buildings has maintained a strict quality policy encompassing design, materials, and the manufacturing process. We feel we can therefore say with confidence that, *"We make relocatable buildings built to last!"*.

2.0 SERVICES

Our service does not end with the product itself. If required, we can handle any project on a 'turn-key' basis.
We can provide all of the following services.

- Site surveys.
- Design of virtually any shape of building required.
- Design of foundations and floors.
- Applications for building regulation approval.
- Manufacture of buildings and shelters.
- Construction of foundations and floors.
- Electrical, heating, lighting, ventilation, dehumidification, air conditioning services etc.
- Transport.
- Erection.
- After sales service.

3.0 DESIGN CRITERIA FOR BUILDINGS

Rubb buildings are available in accordance with UK Building Codes with respect to wind and snow loads. They are designed in strict accordance with the following British standards and codes of practice:

BS 648:	Schedule of weights of building materials
BS 4360:	Weldable structural steels
BS 4848:	Hot rolled structural steel sections
BS 5950:	Structural use of steelwork in building.
BS EN 10219:	Cold formed welded structural sections.
BS 6399:	Part 1 - Code of practice for dead and imposed loads.
BS 6399:	Part 3 - Code of practice for imposed roof loads.
CP3 Chapter V	Basic data for the design of buildings,
Part 2:	Chapter V, loadings Part 2 - wind loads.

Rubb standard buildings are designed for a basic wind speed of 46m/sec (103mph), a 5 year category 3 exposure, and a basic snow load of 75kg/m². Most Rubb building ranges are also available to US BOCA code based on 35psf snow load and 90mph wind load.
The buildings can be designed to a higher wind load (e.g. 120 mph) for customised projects. Higher snow load capacity can be achieved by reducing the modular distance between trusses.

4.0 MATERIALS

4.1 The steel structure: The hot-dipped galvanised steel structure of a Rubb building generally takes the form of a series of lattice tubular or box section steel frames at 3 to 5 metre centres. Tubular purlins span between each of the frames and provide the necessary support for the cladding. Each frame is composed of smaller more manageable sections, which bolt together on site. Buildings spanning up to 80m are available in any length. The hot-dip galvanised coating of all steelwork offers excellent corrosion protection with an estimated life in excess of 30 years. The high quality finish provides excellent resistance to transportation and erection damage.

4.2 **The cladding:** All buildings are clad with tough PVC impregnated polyester fabric. The sheets are sectioned in accordance with the length of the building and joined with special overlap joints. These joints are waterproof and able to withstand vibrations caused by high winds. The membrane is tensioned over the steel structure and anchored to the foundations. The quality fabric has a life expectancy of up to 25 years depending on environmental conditions. Moreover, due to ease of erection and attachment, the cladding can be replaced easily.

4.2.1 **Fabric quality:** Rubb buildings erected over 20 years ago still have their original cladding. The fabric has been tested with respect to tensile strength, elongation, tearing strength, bursting strength, coating adhesion and resistance to flexing according to BS 3424. The fabric is flame retardant and self-extinguishing to BS 5438 Test 2B (test certificates are available on request).

Rubb Quality 453 and 480 PVC impregnated Polyester Fabric

	453	480
Fabric:	Polyester	Polyester
Construction:	9 x 9/cm² - plain	12 x 12/cm² - 2/2
Dtex:	Weave 1100/1100	Panama 1100/1100
Total Weight:	Approx. 700g/m²	Approx. 800g/m²
Thickness:	Approx. 0.7mm	Approx. 0.8mm
Tensile Strength:	2200/2200/N/5cm	3000/3000/N/5cm
Tear Strength:	450/450N (Tongue Tear)	1000/800N (Tongue Tear)
Fire characteristics:	Self-extinguishing Flame retardant	Self-extinguishing Flame retardant

4.2.2. **Fabric options: Colours**
Virtually any colour is available on request, but our standard stock colours are:

- White translucent (usually used for roof sections for maximum natural daylight transmission)
- Blue
- Dark Brown (off white inside)
- Nato Green (off white inside)

UV stabilised
For hot, tropical climates we can offer fabric as above which is UV stabilised using an extra coating containing Titanium Dioxide pigment.

Camouflage / infra-red reflective
Membranes of PVC coated polyester fabric with external camouflage colouring and infra-red reflective material can be supplied.

NBC resistant
The structure can be supplied with an inner skin of polyethylene or polypropylene which can meet requirements of nuclear, bacteriological and chemical containment.

5.0 FOUNDATIONS

The preparation of a site for a Rubb building is usually the customer's responsibility. This would include site clearance and construction of the foundations. However, as previously mentioned, Rubb can act as the main contractor on any project.

Foundation requirements vary considerably depending upon the building size, intended period of exposure and on ground conditions. The smaller buildings may be fitted to a timber frame or a steel channel which can be bolted to a suitable existing concrete slab or anchored by ground anchors or other alternatives. The larger buildings can be bolted to a purpose made concrete ring beam or fitted to a steel beam which could be bolted to a suitable existing reinforced concrete slab.

The main frame of the building is designed for "pinned" base conditions. This results in relatively simple foundations, there being only nominal moments applied to the base. The buildings can be erected on an uneven surface or a sloping area and will accept high differential settlement of the foundations.

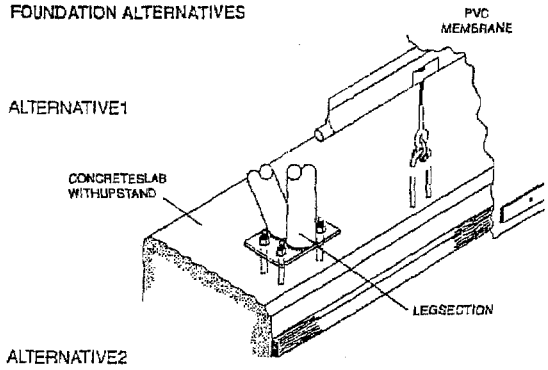
For a permanent solution, most customers provide a concrete slab with ring beam on which to secure the building. A concrete upstand can be either monolithic with foundation beams, or cast on top of an existing slab. Composite action in the latter case may be achieved by drilling the existing slab and grouting in reinforcing bars around which the concrete forming the new upstand can be poured.

5.1 **Buildings on wheels:** Rubb buildings can be fitted with wheels using a continuous steel foundation. The larger structures are fitted with wheels and run on rails. Smaller shelters can be fitted with rubber tyred wheels.

continued

5.2 **Lifting a building:** When a building is to be lifted, a continuous steel foundation along the length of the structure is essential. This can be an angle or U-channel for small units or I- beams for larger structures. Buildings can be lifted using the correct sling arrangement and lifting beam. Normally, 4 modules can be lifted using a 6 legged sling without the need for a lifting beam .

FOUNDATION ALTERNATIVES



6.0 DOORS

Rubb buildings can be fitted with any door arrangement. Large doors are preferably located in the gable ends. Doors up to 4.6m width (depending on building configuration) can be fitted in the side of a building as standard. For customised projects larger doors in the side are possible (see brochure).

Our standard doors are as follows:

- Access door (standard 0.8m wide x 2.0m high)
- Roller shutter doors (up to 7.0m wide x 5.0m high)
- PVC folding doors (up to 5.5m wide x 4.4m high)
- Sliding aircraft doors (up to 20m wide x 6.0m high)
- Folding aircraft doors (up to 18m wide x 7.0m high)

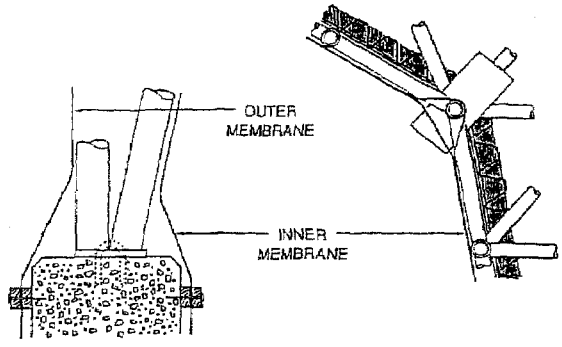
We can however, supply any door configuration required, *building size permitting. We have supplied doors over* 70m wide and up to 12m high.

7.0 ELECTRICS AND LIGHTING

The white translucent roof provides a good level of natural light during day-light hours. However, we can design and install complete lighting and electrical requirements to suit the activity within the building. *All types and standards of light fittings and installations are available* ranging from the Fluorescent Batten, Hi-bay or Lo-bay type to the special purpose flame-proof and water-proof fittings. Our buildings can *also be installed with emergency lighting to BS 5266 and Fire Alarms* to BS 5839. The complete installation will be carried out in strict accordance with the current I.E.E. Regulations. Kit form lighting can be *provided for connecting to generators. All fittings can be attached to, or* suspended from the building structure. Savings on lighting costs due to the translucent roof membrane are substantial.

8.0 DOUBLE SKIN INSULATION

Heat loss can be reduced in our buildings by the provision of an inner skin attached to the inner structure. By adding an insulating material between the two skins, it can be made to comply to the latest British Standards Building Regulations. Various types of insulating material which can be used to suit individual requirements / preferences include, standard glass fibre and Rockwool.



9.0 VENTILATION

Ventilation is required to:

- Avoid condensation
- Maintain air quality
- Avoid unpleasant heat exposure

As standard, the Rubb building is supplied with vent openings in the gables to allow some natural ventilation. Other openings can be positioned in the side walls to provide a higher level of natural ventilation. These openings can be fitted with ventilation fans to provide the recommended number of air changes per hour, to suit the activity within the building. Special ventilation i.e. paint spray, fumes, soot and exhaust extraction can also be accommodated within our services.

10.0 HEATING

As part of the service we also undertake a comprehensive heating installation designed to comply with individual requirements and locations. We can utilise existing sources on site, i.e. gas, steam, LPG, oil, electric etc. We can also undertake the supply and installation of oil storage tanks. Heating units including the re-circulation type can be located either inside or outside the building and supplied with various types of ductwork to provide the correct environmental conditions for the activity within the building.
Where air movement is not considered desirable - e.g. Sports Halls, radiant systems utilising gas or electricity can be installed.

11.0 DEHUMIDIFICATION

It is commonly held that a store must be heated to prevent moisture problems. This is not the case and savings of up to 75% can be made using dehumidification as compared to heating. Due to the fact that *Rubb structures are covered in an air tight fabric they are ideal for* dehumidified storage. A ground sheet can easily be welded to the side walls to prevent rising damp from any existing floor slab. Rubb can supply complete dehumidified storage systems for use in existing warehouses and other buildings. These may consist of total structures, custom fit bags or drop shrouds.

12.0 AIR CONDITIONING

Air conditioning can be provided for the whole or specific areas within the building to suit the clients requirements. In general, all other pipe services, e.g. compressed air, water, gas or oil can be installed.

13.0 AIRTIGHT AND LIGHT INHIBITING STRUCTURES

Rubb has extensive experience in designing, manufacturing and erecting structures which are required to be virtually airtight and at the same time must inhibit light ingress. Such structures are of particular use in the water treatment sector where air tightness prevents unpleasant odour escape, and algae growth is inhibited by providing light-proof conditions.

14.0 SHELTERS RANGE

Rubb shelters have a similar specification to buildings, but because they are designed for more temporary usage they do not conform to UK Building Regulations for wind and snow loads. Rubb manufacture standard shelter kits in the THA, THB and TH ranges as shown in the tables. Any length can be supplied in 3m long modules for all shelter designs. Models THA, THB have vented gable ends which are welded to the first roof section for extra rigidity. All shelters are easy to erect by unskilled labour with no special tool requirements.
A typical kit comprises, steel frame, all fixings, PVC coated 453 polyester fabric, integral steel ringbeam, vent duct, single or double lace up or folding door and erection documentation. Framework is hot-dipped galvanised tubular steel. Joint design is mostly spring clip style with few loose bolts. The fabric membrane is self-extinguishing.

15.0 OPTIONAL EQUIPMENT/SERVICES

1. **Door Alternatives**

a. Rubb PVC folding door (incl. as standard on THA and THB).
b. Steel roller shutter door.
c. Lace up doors (incl. as standard on TH).
d. Personnel doors.

2. **Foundation Alternatives**

a. Ground anchor kit for virgin land with steel spikes.
b. Ballast weight kit: (ballas: not included).
c. Expansion bolt kit for fastening to concrete.
d. Bolts for resin anchoring (hard core/asphalt).
e. Steel foundation, hot dip galvanised (incl. as standard on THA and THB).

3. **Kit for lifting**
4. **Ground sheet**
5. **All white fabric tropical quality**
6. **Lighting kit**
7. **Wheel system**
8. **Clear windows**
9. **Customers' company logo/name on shelter**
10. **Complete erection and supervision**
11. **Ventilation fan**
12. **Ventilation ducts (incl. as standard on THA and THB in each gable)**
13. **Steel clad walls**

SEE BACK PAGE FOR SPAN PROFILES OF SHELTERS

16.0 WEIGHTS AND DIMENSIONS *standard shelters*

TH RANGE

Dimensions(wxl)(m)	3x6	4x6	5x6	7x6
Weightincludingcover(kg)	410	425	446	469
Weighttoeach3mext.(kg)	146	155	165	176
Standarddoor opening(wxh)(m)	Single lace-up	2x2	2.5x2	3x2.5

THA RANGE

Dimensions(wxl)(m)	6x5	8x9	10x9	12x9
Weightincludingcover(kg)	1099	1652	1881	2269
Weighttoeach3mext.(kg)	281	321	351	434
Standarddoor opening(wxh)(m)	3.3x3.3	3.5x3.8	4.5x4.1	5.5x4.4
Volume/nm³ perm² floorarea	3.67	4.17	4.47	4.75
Snowloadingcapacity(kg/m ²)	109	95	45	55

THB RANGE

Dimensions(wxl)(m)	7x9	9.75x9	13x9	-
Weightincludingcover(kg)	1451	1757	2205	-
Weighttoeach3mext.(kg)	268	325	429	-
Standarddoor opening(wxh)(m)	3.0x2.7	4.5x3.1	6.0x3.5	-
Volume/nm³ perm² floorarea	3.11	3.51	3.95	-

17.0 SHIPPING

Rubb buildings and Shelters, being of modular construction can be crated, strapped in bundles suitable for handling by crane or truck, or packed into standard ISO containers for shipping by sea, air, rail or road.

18.0 ERECTION

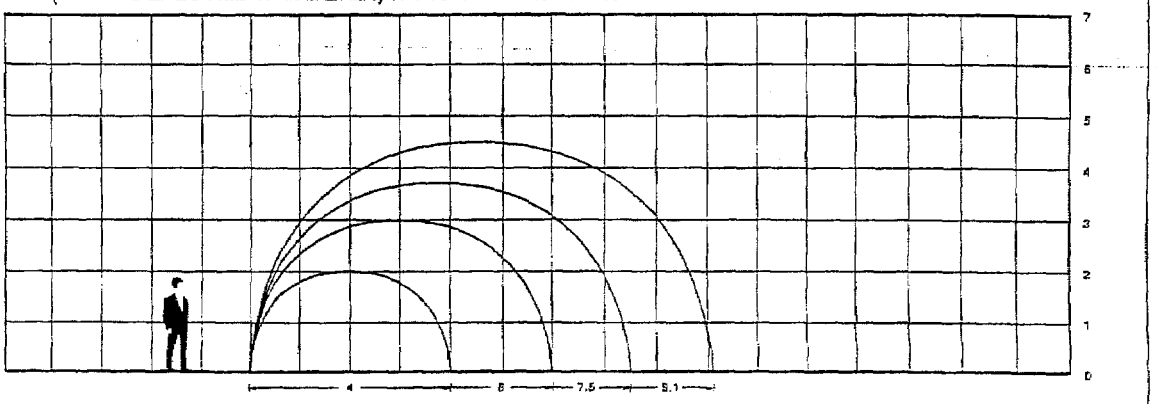
Rubb buildings and Shelters are designed to be speedily erected with minimum equipment. Buildings can be erected using customers' own labour (we can assist by providing an erection supervisor on an hourly basis), or by a Rubb erection team at a fully inclusive price.
Rubb have extensive experience in this field and can offer this service anywhere in the world, improvising with minimum equipment where necessary.

19.0 QUALITY ASSURANCE

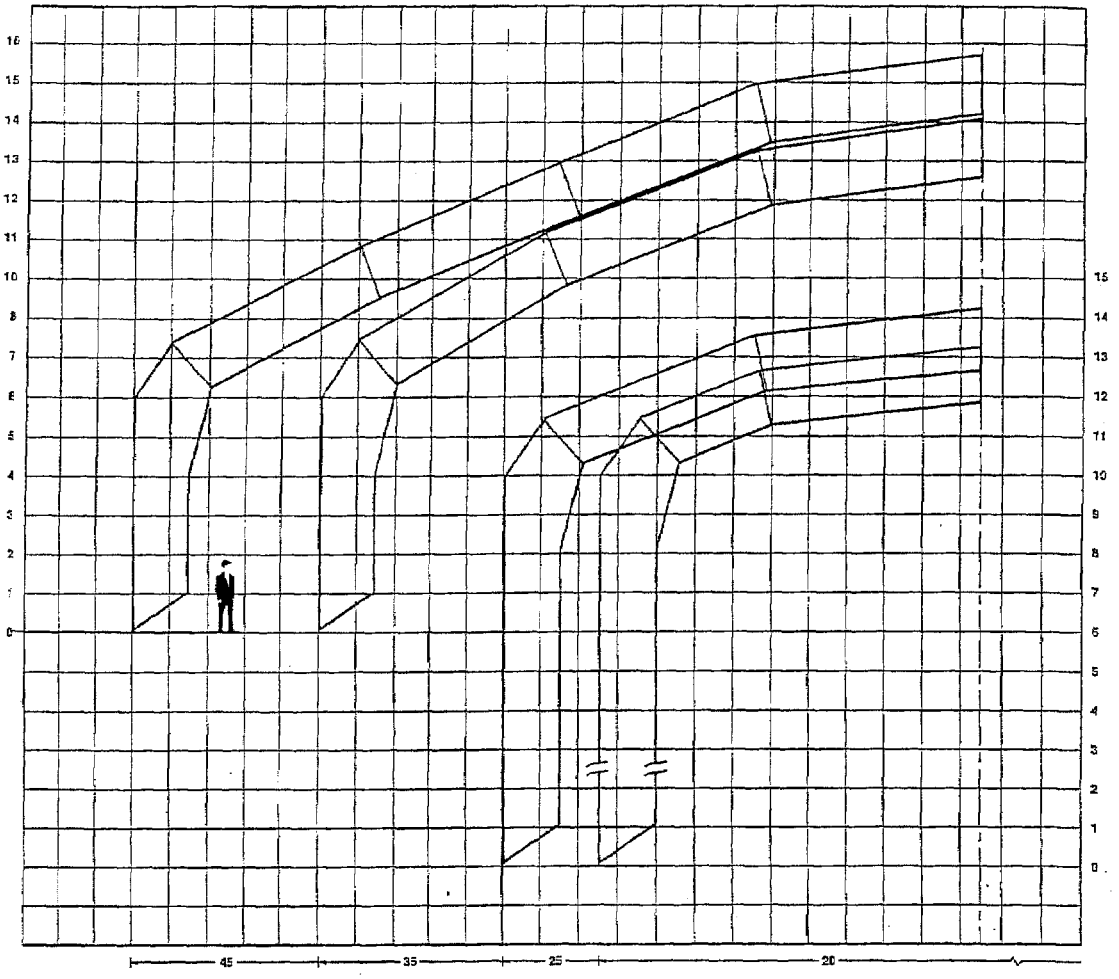
Rubb designs, manufactures and erects structures which conform fully with ISO 9001 Quality Assurance standards. Rubb also meet the requirements of Nato and US military codes of conformity. Leading insurance underwriters have, after exhaustive testing, approved Rubb buildings, from a fire safety aspect, for housing £57.5m aircraft.

20.0 STANDARD PROFILES OF RUBB SHELTERS *all dimensions in metres*

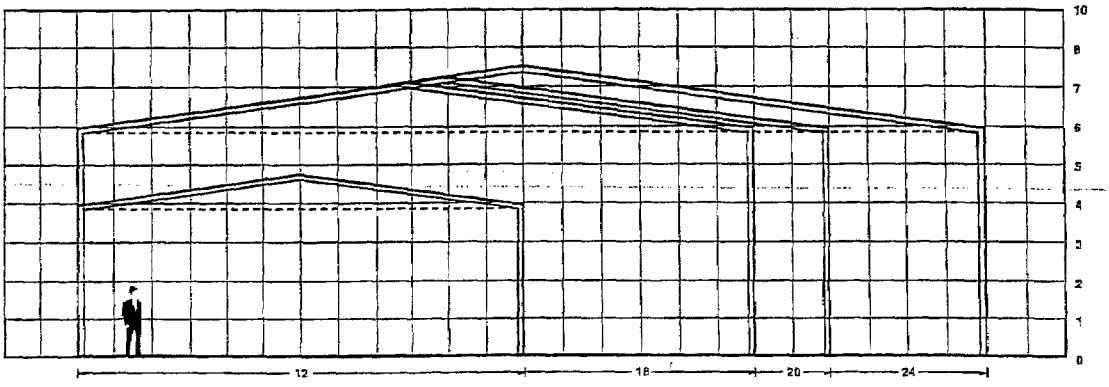
RDS (RAPID DEPLOYMENT SHELTER) RANGE OF SHELTERS



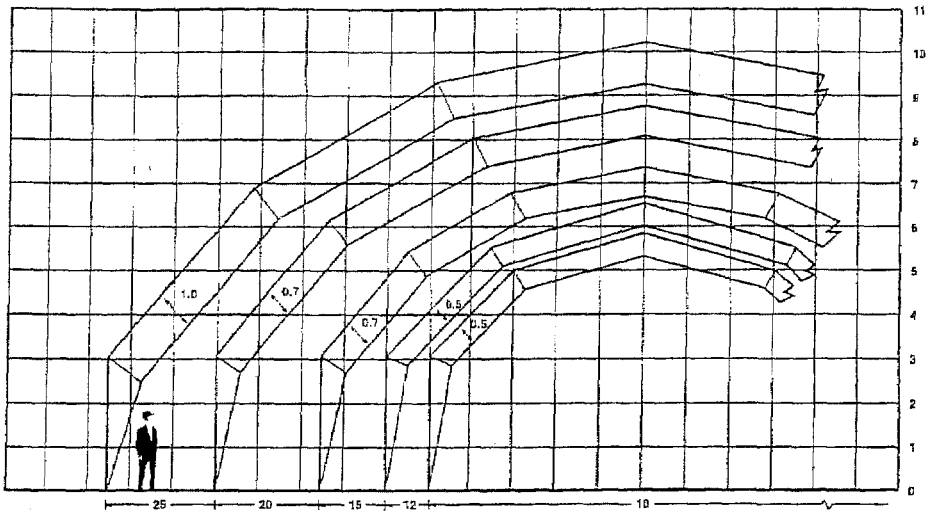
BVL RANGE OF BUILDINGS With spans up to 80m. (not shown) and sidewalls up to 20m. adjusted to customer requirements.



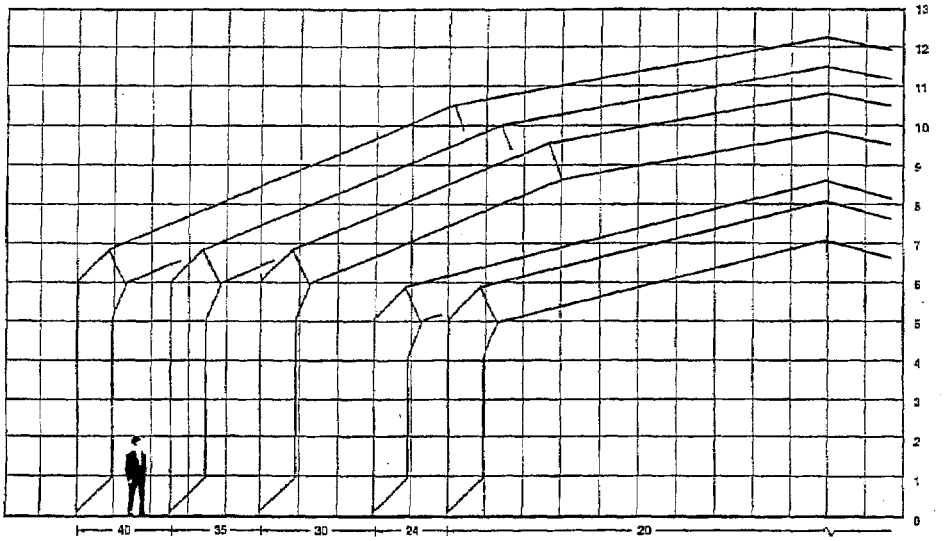
BVR RANGE OF BUILDINGS Special purpose Rapid Erection structures and Sunshades.



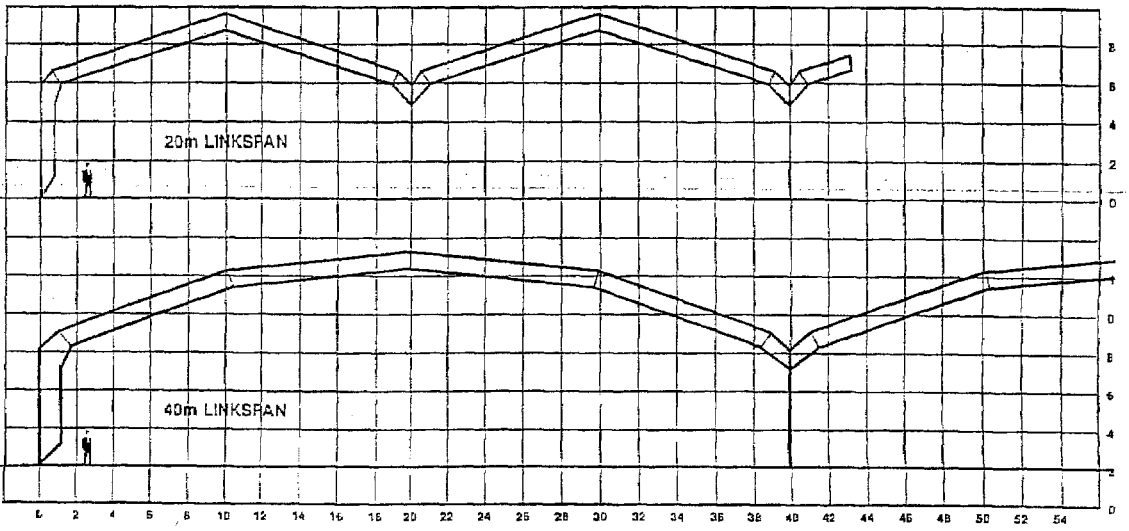
NV RANGE OF BUILDINGS With 3 m sidewalls. Alternative sidewalls optional.



BVE RANGE OF BUILDINGS Available in single span configurations, alternative sidewalls optional.



BVE RANGE OF BUILDINGS - LINKSPANS Also 24m, 30m and 35m spans available.



FOUNDATION ALTERNATIVES

TH RANGE: With the TH, no foundation frame is included. A foot plate is welded to the bottom of the leg section. This can be bolted to a wood foundation with coach screws or on to a steel channel foundation shown in figs 1. and 2.

THA AND THB RANGE: *With these* shelters a continuous steel angle foundation is included.
Alternative foundation arrangements are shown in figs. 3, 4 and 5.

FIG1

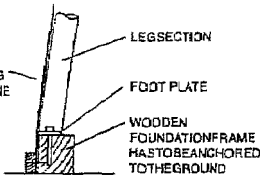


FIG2

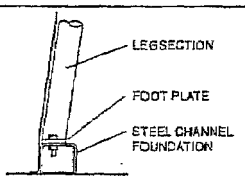


FIG3

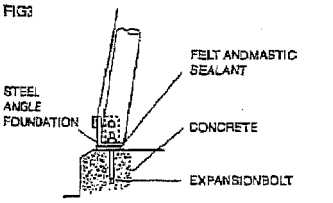


FIG4

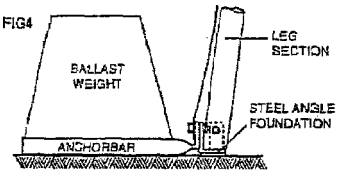
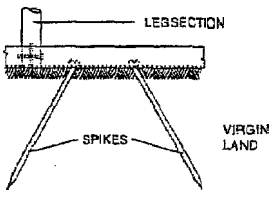


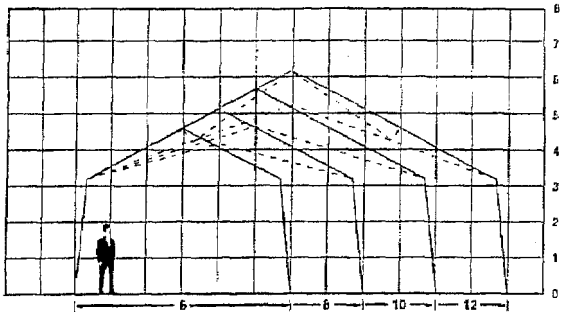
FIG5



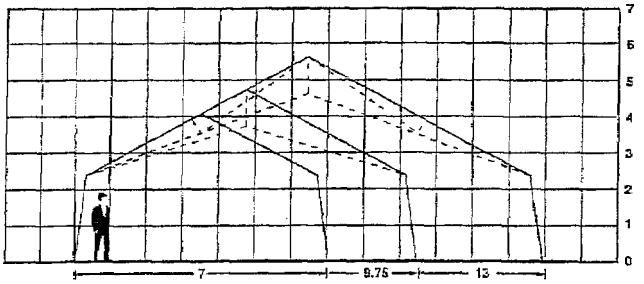
N.B. Shelters to be lifted or fitted with wheels require a steel foundation frame.

IMPORTANT: The user is responsible for securing the structure to the ground. Depending on ground conditions, anchor hooks may not be sufficient. Any additional anchoring down arrangements to secure the structure are the users responsibility

THA RANGE OF SHELTERS

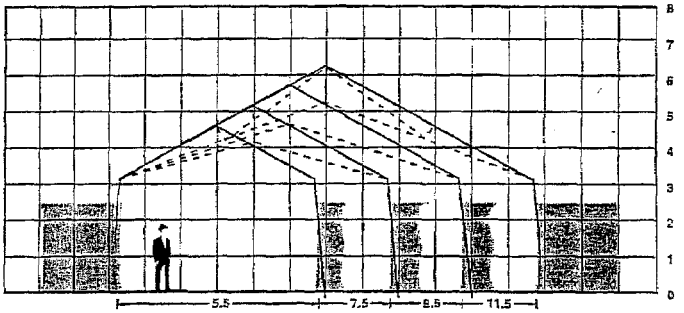


THB RANGE OF SHELTERS

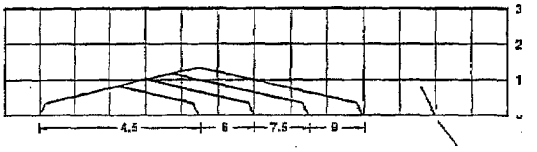


CVB RANGE OF SHELTERS

Designed to be mounted directly on a standard ISO container



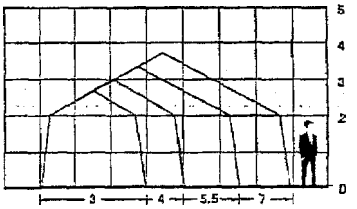
CXB RANGE OF SHELTERS



Concretedrying shelters,orplaying surfacecovers,up to9m.spans.

1m.extensionlegtoallowextraworking heightforwetweatherconcretelaying

TH RANGE OF SHELTERS



In the interests of product development Rubb reserve the right to alter specifications without prior notice. The information provide here is for guidance only and does not form any part of contractural offer.

We Cover The World®
RUBB BUILDING SYSTEMS

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Made in England, also USA and Norway

ISO 9001 SGS

AN INTERNATIONAL COMPANY